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REFUSE DESTRUCTION AND POWER PRODUCTION.

THERE is only one way properly to dispose of refuse, and that way is by burning it. This is no new fangled idea, as the burning of refuse was practised by the Israelites in the Wilderness thousands of years ago. What kind of furnace they used, or whether it was merely burnt in heaps as garden rubbish is to-day, we have no record, but it is certain that it was burnt for sanitary reasons, and not with the idea of utilising the heat of combustion for the production of power. The custom of burning up all refuse was one of the measures taken to prevent the spread of leprosy and plague; and these diseases having, to a very large extent, been got rid of, the custom fell into disuse.

But, although leprosy and plague have been practically stamped out, many of our more modern complaints, such as typhoid, cholera, yellow fever, dysentery, &c., are caused by, or aggravated by, the smells or gases given off by refuse tips.

To bury refuse in the ground is not to get rid of it. The disease germs may be kept in a state of suspended animation for ages until the soil is disturbed, when they break out again in their most pestilential forms.

Thus epidemics have been traced to the opening up of burial grounds which have been disused for from 200 to 300 years. The cholera scourge which visited London in 1854, the plague epidemics in Egypt and Madeira, and in Minchinhampton in the first half of the last century, were all traced directly to such causes.

Nor is the simple burning of refuse in heaps sufficient to render it entirely innocuous. Whilst many disease germs may be annihilated by such means, others are merely driven off into the atmosphere in the smoke and gases. To render the refuse and residuals entirely innocuous, it is necessary to raise them to a temperature of at least 1,250° F., and not only so, but to keep them at this temperature for a considerable time.

Until within the past 30 years there appears to have been no attempt to design a satisfactory furnace to deal with refuse in large quantities. In the early designs the furnaces were of comparatively low temperature, and the refuse was cooked rather than burnt; and, notwithstanding the high chimneys used, the stench given off was unbearable. "Fume cremators," or secondary furnaces, were introduced, with the object of getting rid of the smells, but it was not until the advent of the high temperature furnace, in which the temperature ranges from 1,500° F. to 2,500° F., that the problem of the sanitary disposal of refuse could be said to be practically solved.

Two difficulties still remained, viz., the prevention of the emission of fine dust from the chimney, which is driven off from the residuals and carried into the flues; and the

disposal of the residual clinker and ash, which amount to from 25 to 30 per cent. of the weight of refuse dealt with.

The economical disposal of the latter has given rise to several new forms of industry, such as the manufacture of bricks, mortar, and artificial stone from the crushed clinker, whilst the fine powder is used as a base for the manufacture of disinfectants. Where there is a large and steady demand for the above products it is sometimes possible to entirely cover the cost of disposing of the refuse. This is the case at Bradford, where a profit of some hundreds of pounds is made annually by these means. The surplus heat from the destructors is used to raise steam for the crushing machinery. The clinker also forms a good under bed for roadways, and is an excellent substitute for coke in sewage filter beds.

The question of power production from refuse destructors is one which has given rise to considerable controversy. Some few years ago there was a tendency to make this the primary instead of the secondary consideration, and destructors were erected from which great things were expected in the way of power.

The result was disappointment, and not only was very little steam produced, but, by making this the aim, the efficiency of the furnace as a refuse destructor was sacrificed, and the destruction of refuse by burning was discredited. That considerable surplus heat is given off from a properly designed destructor—that is, a destructor designed primarily for the absolute cremation of refuse—is indisputable; but to argue from that, that power production from a destructor is always profitable, is fallacious reasoning, and does more harm than good.

Many excellent results in steam raising have been obtained from refuse destruction, and there are a few small electricity works depending almost entirely on the destructor furnace for steam. This, in itself, does not prove it to be a profitable method of steam raising. It is only profitable when the total costs of destruction are less than the cost of coal and coal firing. Thus, granting that in some localities the calorific value of the refuse is one-fifth that of coal, it means that instead of firing 1 ton of coal, 5 tons of refuse must be fired. And more than this, for every 5 tons of refuse fired, from 1½ to 2 tons must be handled in the form of clinker. The labour item must, therefore, be six or seven times as much as for coal, assuming the stokers are kept fully employed in each case.

But in a small electric light station firing only about 1 ton of coal a day, the cost per ton is high, and the cost of 1 ton of coal plus firemens' wages, would probably amount to more than the total costs of dealing with 5 or 6 tons of refuse. The cost of destroying a ton of refuse may be reckoned at 2s., viz., 9d. per ton for firing, and 1s. 3d. for standing charges. But in such a station as we are assuming the load occurs during only a small portion of the day, whereas the refuse would need to be burned during eight to ten hours. This necessitates storage, and probably a part of the storage charges would have to be debited to the destructor.

Without following this line of argument into too great detail, it will be clear that as the station grows the cost of coal firing will gradually fall, until the stokers are continuously employed, when the stoking cost per ton, for either coal or refuse, would be equal; so that the comparative cost for equal evaporation would be under 9d. for coal, and about 12s. for refuse, thus leaving 11s. available towards the cost of the coal itself.

It is clear, therefore, that in large supply stations the financial value of refuse as a steam raiser is, at the best, inconsiderable, although in the early stages of a small station it may be sufficient to supply the whole of the steam required, and thus help to pay part of the costs of destruction.

The point we again wish to impress is that refuse destruction is, primarily, a sanitary question, power production being necessarily a secondary consideration.

Parallel Running of Alternators.

In years gone by it was not supposed that two or more separately-driven alternators could be coupled up to the same circuit and add their joint efforts in supplying power to it. In 1884, however, the late Dr. John Hopkinson showed that while two alternators could not both act as generators if coupled in series, it was quite possible for them to deliver power to the same circuit if connected in parallel.

It is now a matter of common experience that any alternator can be run in parallel with any other alternator. A single-phase machine can be synchronised with one phase of a polyphase machine, or one phase of a polyphase machine with one phase of any other polyphase machine.

It must not be supposed, however, that the parallel operation of alternators is a simple matter, or one that requires no more care than similar working of direct-current machines.

Alternators in parallel must have the same periodicity and the same terminal voltage. If these conditions are not satisfied local currents will flow in the closed circuits formed by the armatures, and not only the whole work of feeding the external circuit may fall on one alternator, but it may actually be driving the others as synchronous motors.

If two alternators in parallel have the same frequency but different terminal voltages, the local current flowing between the two machines will be wattless and leading in the one of lower field excitation and lagging in that of higher field excitation, with the result that there is a tendency to restore equilibrium by strengthening the weaker field and weakening the stronger one. This tendency to maintain equal terminal voltages is due to armature reaction, hence alternators for parallel running should not have low armature reaction or they will be too sensitive to variations of field excitation.

Provided, then, that alternators have a sufficiently high armature reaction, sudden variations or differences in terminal voltage become automatically rectified when operating in parallel.

Equality of frequency is by far the most necessary condition for successful parallel operation. There should, in fact, be no tendency to inequality of frequency, which is equivalent to saying that the regulation of the prime movers must be the same. If of two prime movers driving parallel operating alternators one has closer regulation than the other, it will take more than its share of an increasing load and less than its share of a decreasing load. Further, tendency to inequality of frequency causes local energy currents to flow from the accelerating machine to the retarding machine, and relieves the latter at the expense of the former.

With prime movers of the reciprocating type, such as steam engines, the frequency is not constant, but pulsates; and we may go as far as to say that to produce the best effects with parallel operation, not only should the average periodicity be the same in two alternators so working, but the speeds of the prime movers should be identical, and the

number of poles of the alternators the same. Unless this is the case, the difference in the pulsations of the prime movers will have the effect of causing local currents to flow in the circuit of the armatures, and the capacity of the plant for a given rise of temperature will be correspondingly diminished.

The phenomenon of "hunting," so frequently experienced, is entirely due to the magnetising or demagnetising effects of local armature currents. Get rid of these, and all the difficulties of parallel operation will disappear.

With direct current machines running in parallel, the only precaution to be observed is that the terminal voltages are always the same; but with alternators the periodicities must be the same at each instant, otherwise deleterious local currents will appear. A momentary difference in periodicity will result in a local armature current increasing the field strength of one machine and diminishing that of the other, with the result that a diminution of the capacity of the plant takes place accompanied by the phenomenon of "hunting."

Whenever hunting occurs, the plant is not working to its full capacity for the currents in the armatures.

We have stated, and this should be borne in mind by designers of alternators, that a certain amount of armature reaction is necessary to successful parallel operation. In fact, if it were possible to build alternators in which armature reaction was entirely absent, such machines could not be paralleled. It can be shown that the maximum synchronising power exists if the synchronous reactance of the combined plant is equal to the total resistance of the circuit.

Liquid Fuel.

THE subject of liquid fuel is very much to the fore at present. There are reasons for this, more or less sound. Of the sound reasons convenience, cleanliness, and elasticity come foremost. Of the unsound reasons, there is the idea that liquid fuel might be universal if people would only realise its advantages. To show the fallacy of this, it only remains to point out that the present production of liquid fuel is only some 2½ per cent. of the annual coal production of the world. Liquid fuel, however, has its uses. In Texas, it is supplied in certain districts to factories through mains similar to water pipes in the streets. This is an ideal method of getting fuel into a factory. Liquid fuel requires no hard labour in stoking. A large battery of boilers can be looked after by one or two men who have simply to attend to water gauges and regulate the fuel by cocks to suit the steam supply. At sea, the difficulties of stoking and of trimming are reduced to a minimum, and fuel can be brought from distant bunkers; the conveying of coal to the firemen is by no means a simple problem in a high-powered steamer.

While one might hesitate to advocate the sole use of liquid fuel in an electric station, it may well be employed to get over the sudden loads due to fog, or the ordinary peak load which lasts so short a time and makes such demands on the stokers. A liquid fuel fire, especially when combined with a coal furnace, is capable of instant maximum effort, and the effort can be as quickly stopped. A large proportion of the power of a chimney is used up in overcoming the resistance of the solid fuel on the grate. With all liquid fuel this resistance is cut out, and a very low chimney will serve its purpose. One of the vexed details of liquid fuel combustion is the agent for atomising it. It is assumed that atomising at present offers the only practicable method for heavy oils and thick tars. The two agents are compressed air and steam, and in either case they should be used hot. There are special reasons for superheating the steam, because, if not superheated, there is grave risk of water coming over, and a sudden splash of water will often extinguish the fire, so that the oil which still continues to be fed in is apt to vaporise on the hot brickwork and produce gas, which may in turn cause serious explosions in the flues, and back flaming from the furnace door to the danger of the attendants. With hot air no such danger can occur, and air has also the advantage that it must be used for combustion, whereas steam is not a supporter of combustion. At the same time it appears probable that there is a certain useful action of steam which promotes combustion, and the best agent for atomising has, perhaps, yet to be determined. In any case, the highest practicable temperature of both steam or air and fuel, all helps to better atomise the fuel. Needless to say, it is found essential to employ a good deal of firebrick about an oil-fired furnace both to ward off the cooling effect of the furnace plates from the burning fuel and to serve as a check on the too rapid rush of the burning gases through the flues. Liquid fuel is perhaps the ideal; but it must be dealt with in a cautious and conservative spirit. It would never do to use it universally, for there would not be enough to go round. Someone will profit from the use of liquid fuel. The profit should be equitably divided between the seller and the user. At present, however, the experience of would-be users of oil fuel, is that the seller seeks an unduly large proportion, and the commercial advantages are correspondingly diminished.

Smoke Abatement.

THIS is a perennial subject which brings in its train an unlimited host of patent appliances, most of which ignore the essentials of perfect combustion. The cause of smoke is simply the same which causes a deposit of soot on a vessel of water when brought down upon a gas flame. The gas flame alone is burning without smoke; there is perfect combustion of hydro-carbons in progress. A water-cooled pan is made to touch the flame, and soot is at once produced where till then combustion had been perfect. These facts are ample to convey an obvious lesson, but the lesson remains unlearned by engineers and others who ought to know better. The essentials of smokelessness are so well known that there is no excuse for nine-tenths or more of the so-called smoke abatement appliances. The Bunsen flame is smokeless because of the very complete admixture of air and combustible; it does not even produce smoke when placed in contact with cold vessels. But the cruder hydro-carbons of distilling coal must have not only good air admixture, but also high temperature; they will then burn smokelessly with economy. It is hopeless to expect economy without high temperature, although an excess of air will reduce or prevent smoke; but this is wasteful and unscientific. The water-tube boiler, for many years, earned for itself a bad reputation as a smoke producer; this was probably because the ordinary setting employed in these boilers was hopelessly bad and unscientific. Even Welsh coal—commonly known as smokeless from its behaviour in ordinary shell boilers—will produce volumes of smoke in badly-arranged water-tube boilers. Smoke is one of the results of neglecting the common knowledge of chemistry, which, if equally neglected in other directions, would bring failure and disaster in its train. The law provides for smoke prevention. A society has been formed for the purpose of putting the law in motion. At the meetings of this society one hears absolutely nothing technical, but much of abuse and a good deal about the dirtiness of smoke. Everyone knows smoke is dirty, and everyone ought to know that it is unnecessary and wasteful—far more unnecessary, by the way, than wasteful, yet still wasteful. It is a great pity that black smoke is not very wasteful indeed, for if it were, the known methods of preventing it would be adopted. Being so little wasteful, engineers and steam users allow themselves to be bamboozled by all manner of devices which they should know cannot effect their purpose. With liquid fuel, combustion is made perfect by suitable furnace construction. Without such means, liquid fuel would produce a lot of smoke of a very disagreeable nature. Coal smoke is much less offensive, or it also would be prevented.

D

THE GAS ENGINE AND ITS FUTURE.

(*Continued from page 328.*)

The Simplex Type.

If the largest number of gas engines have been made by Messrs. Crossley Bros., and the highest average power units up to the present by Messrs. Gebr. Körting, the credit for cylinders of a diameter of 51 in. is due to the Société Cockerill, of Seraing, whose English licensees are Messrs. Richardsons, Westgarth & Co., Ltd., Middlesbrough. On the strength of results obtained with a 200-H.P. engine, the Cockerill Co. launched out in the direction of the increase of cylinder diameter, for engines to use blast furnace gas, and are now building engines of much higher power; two such cylinders, arranged tandem, develop 2,500 H.P. A plan of one of their engines is shown in fig. 1.

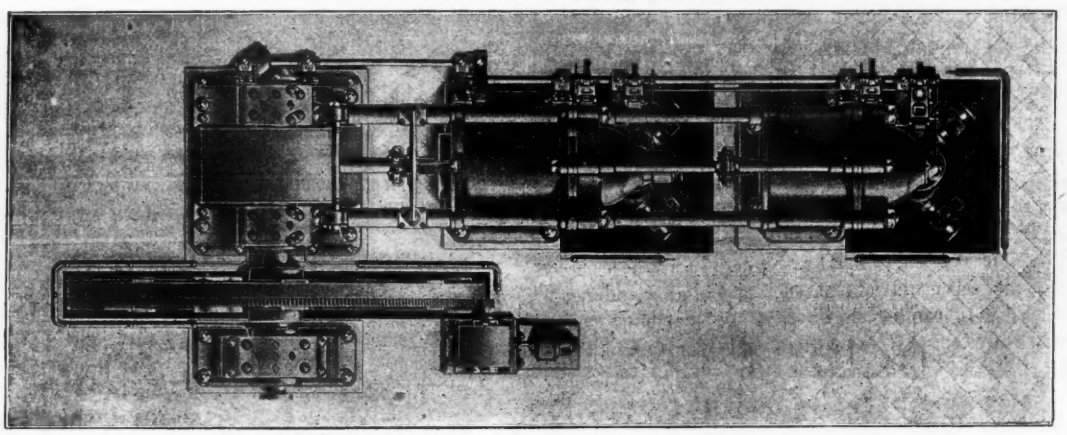


Fig. 1.

The Simplex engine was originally designed by M. Delamare Debouteville, to whom great credit is due for the courageous manner in which he attacked the problem of increasing the cylinders of gas engines, and their application to blast furnace gas. In the hands of the Société Anonyme Cockerill the power of single cylinders has been increased up to 1,250 H.P.

The chief characteristic of the "Simplex" engines is their strong construction; they work on the Otto cycle, having ample water-cooling arrangements for the jacket, piston, &c., as well as for the main bearings. With the object of facilitating the expulsion of any dust that may accompany the gas, the main valves are situated at the lowest point. When designed for direct-driving dynamos the number of revolutions is kept as high as possible, a speed of 150 revolutions per minute being adopted in engines of 600 H.P. To allow of this high speed, and at the same time keep the weight of the fly-wheel as low as possible, the latter is specially constructed to run at a high rim speed, being of the built-up type in preference to the usual cast-iron type. The side-shaft is driven by bevel gearing in place of the more usual skew, or worm, method. Every part of these engines is well worked out, and where the cyclic irregularity has to be kept low the number of the cylinders is increased so as to increase the number of impulses. The large number of engines built and in hand by the Cockerill Co. is evidence that this type is considerably appreciated for dynamo work.

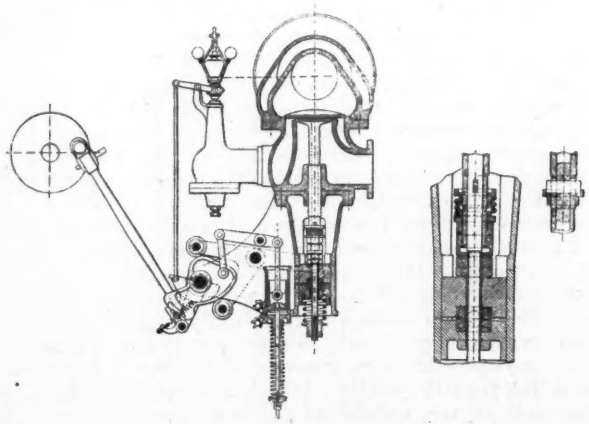


Fig. 2.

Messrs. Richardsons, Westgarth & Co., Ltd., are prepared to undertake the manufacture of engines up to sizes of 5,000 H.P. to work with blast-furnace gas, Mond, or ordinary producer gas, patent coke-oven or town gas, for dynamos or other purposes, that firm having purchased from the Société Anonyme John Cockerill the sole right of making and selling their patent "Simplex" gas engines in England and Wales, and English purchasers have all the benefit of the Cockerill Co.'s great experience under the arrangement. The makers of this type of engine prefer the electric system of ignition.

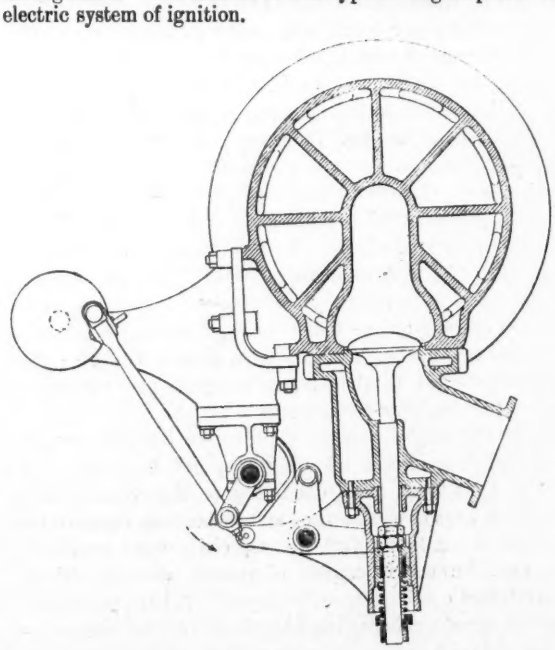


Fig. 3.

For starting purposes a specially designed benzine carburetter is supplied, and each engine is equipped with barring gear to act on the fly-wheel, worked by an electric motor when desired.

The Cockerill Co. are building a double-acting engine of 1,800 H.P., as well as one of 1,200 H.P., so that it is evident that they are advancing with the requirements of power users.

A "Simplex" engine has been running continuously on blast furnace gas since 1898, driving dynamos with results which are said to be most satisfactory.

We are indebted to *Stahl und Eisen*, 1902, No. 21, for figs. Nos. 2, 3 and 4. Fig. 2 very clearly shows the method of governing the mixture of gas and air in proportion to the load. Fig. 3, being a sectional view through the exhaust valve, shows the strong construction of the combustion chamber as well as the disposition of the exhaust port to facilitate the removal of dust, with the method adopted for lifting the exhaust valve.

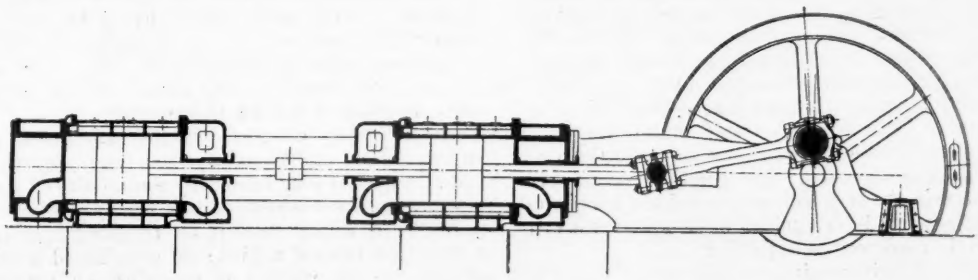


Fig. 4.

Fig. 4 is a sectional view of the 2,500-H.P. gas engine. It will be noticed that though still adhering to the Otto cycle, the two cylinders are made double acting, a crosshead guide being adopted in place of a trunk piston.

This arrangement of tandem cylinders, double-acting, permits of two impulses per revolution, and with a suitable fly-wheel permits of a cyclic regularity suitable for the direct driving of alternators in parallel.

(*To be continued.*)

TANGENTIAL TRACTION.

By E. GUARINI.

(*Concluded from page* 291.)

On concluding this interesting description, M. Dulait conducted the visitors to the trial station for this mode of traction. This station has for several years been the scene of all the transformations and evolutions of this original idea.

Among the visitors were many eminent and skilled electricians and railway engineers, besides representatives of all the principal journals in the capital.

The principal dimensions of the blocks of stators are as follows:—Total length, 2·770 metres; breadth of the polar expansions, ·50 m.; section of core, ·25 × ·16.

Their winding is of the ring type and the number of bobbins 24, or three for each phase; the diameter of the wire of the bobbins is 2·7 mm. The pressure chosen is from 1,300 to 2,000 volts. The stators when completely finished were exposed for four months to the rain and the sun. Then on being subjected to a pressure of 6,000 volts, they withstood it without showing any signs of damage. The stators were placed on solid foundations of concrete. They are fixed to these foundations by 10 bolts, with the aid of bronze supports. These supports rest on wooden cross-pieces embedded in the foundation. On the same cross-pieces are laid the rails of the little track. Thus the rails are connected with the foundation and the stator.

The propeller is 19·50 metres long. The distance between the centres of the stators being 18 metres, the propeller can thus cover one stator completely and half of the next. This length of 19·50 metres corresponds within a little to the length of a two-bogie car. It is divided into 12 compartments, each 1·50 m. long, supported by 13 pairs of wheels, and connected together by mechanical, electrical and magnetic joints, flexible in every direction, so as to accommodate themselves to any curve or irregularity in the track.

As to the electrical construction of the propeller, it might either take the form of the stator, *i.e.*, it might be provided with polar extensions, or the usual form of armatures of triphase motors, provided with slots. In the latter case, the width of the core of the propeller must evidently be equal to that of the polar extensions of the stator. In the experiments that we are describing, the first form was adopted. The propeller had, like the stators, polar extensions.

As regards the winding of the propeller, it is based on the principle of the "squirrel-cage" winding of ordinary polyphase motors. The special feature of the starting rheostat is, that it can modify simultaneously the individual resistance of each bar of the squirrel-cage. For this purpose the bars of this cage, which are connected at one of their extremities by a cross-piece of copper, are extended at the other by bars of nickel-steel. A second cross-piece, fitted with runners ensuring contact with each of the resistance bars, moves parallel to itself and in the longitudinal direction of the bars, thus modifying equally the resistance of each. The extreme position of the movable cross-piece corresponds to the short circuiting of the winding. We may remark that in the experiments the propellers were independent of the two cars, and were attached to them. Fixed to supports mounted on the axles the propeller travels along a special little track within the main rails. This was made with the object of maintaining a constant length for the air-gap, and above all, avoiding any diminution in this length, in case of any inequality in the main track. In short, the quadrilateral formed by the axle, the wheels and the plane lines of the track for any possible inclination of the car, remains unalterable, so that the value of the air-gap remains constant. Moreover, the mechanical construction does not allow the air-gap to be reduced beyond a certain minimum size, say 10 mm. This may, however, be increased in the case of inequalities in the track. This precaution, however, is, in M. Dulait's opinion, superfluous, as the principal rails laid on the foundations of the stators to a great extent ensure the constancy of the air-gap. The propeller is provided with an arrangement enabling the air-gap to be kept within the required limits and providing for the wear and tear of the wheels and rails.

In the construction of the interrupters, the inventors have endeavoured chiefly to make them strong so that they shall require very little attention, and shall be able to stand the frequent breaks at high voltages without the contacts becoming deteriorated.

In order to fulfil the conditions for preserving the contacts, the two-contact system has been adopted, the first being constituted of cones of zinc or carbon, for the break properly so-called, the second, consisting of copper jaws, being used for the passage of the current. Moreover, the first contacts are provided with an arrangement for producing a blast of compressed air at the time of the break only, whereas, when the contacts are at rest, the admission of the air is stopped by an automatic valve. The compressed air is supplied by a Westinghouse pump placed in the workshops and conveyed by a 1-in. gaspipe laid along the track.

There are at present two models of interrupters. As the first, designed at the commencement of the trials, seemed too large, the dimensions of the second were reduced. Both models work very well, continuously cutting off the triphase current of 50 amperes at 1,400 volts.

The trial line, on which we made two journeys, consists of four rails, two of 30 kg. per meter for the car, and two of 15 kg.

for the propeller. It consists of a track 800 metres long, about 400 metres being fitted up electrically. The part not fitted up serves for the stoppage of the train when the electric brake is not applied. The part fitted up, which is level throughout with the exception of a gradient of 4 per cent. in a length of 50 metres, comprises 20 blocks of stators placed at a distance apart of 18 metres from centre to centre. Fifteen of these stators are wound so as to produce two poles, and five others placed at the beginning of the line have a four-pole winding, and are used for the starting, giving an effort nearly double those with two poles, with the same consumption of energy. An overhead line along the track serves to feed the stators, which are all in shunt, so that each stator constitutes a section, and possesses an automatic interrupter. This arrangement has been adopted for the express purpose of having a larger number of interrupters in use. It has often been objected that the greater the number of interrupters the more chances there will be of irregular service. The inventors wished, during the trials to which we were invited, to put themselves under the most unfavourable conditions from this point of view. In practice, of course, the length of section and the number of stators in series would be determined in each particular case according to the conditions to be fulfilled.

In the course of their experiments the inventors were able to show that the objection brought forward against the interrupters was by no means justified; and that, on the contrary, from the point of view of safety and regularity of service, it is better to have the sections as short as possible. In fact, if the sections are short and the interrupters near together, even if one fails to act, the progress of the car will not be affected in the least; the car will be carried on to the next by its momentum, without any appreciable slackening of speed, whereas, with long sections, it may happen that the slackening of speed will be sufficiently great to prevent the regular working of the system. For the control of the interrupters, small triphase motors of 1 H.P. were used, of the usual construction and at low pressure. But in practice, of course, only sectors will be used, and these will consequently be much less costly. These sectors, although wound for low pressure, will be connected together in series, so as to be fed by the high voltage current.

The motors used in these experiments are more powerful than is really necessary, as they were purchased ready made instead of being made to order. They are fed by a separate low voltage line; the current is furnished by a special little generator. The fitting up of the stators is completed by triphase leaden fuses placed on the posts and by two lengths of armoured cable with three conducting wires. One length of cable connects the stator with the fuses and the other with the interrupter.

The installation also includes the arrangement for changing the speed of the car, which is effected by the manipulation of a controller placed on the car. The whole train, weighing about 22 tons, consists of the propeller, properly so-called, which is supported by a special truck rolling on the inner track, and two ordinary tramway cars travelling on the main track. These cars are completely independent of the propeller, but there is nothing to prevent the propeller being added to the car in the practical working of the system. The manipulation of the starting rheostat is effected in the following manner:— At the time of starting the mechanism is worked by hand until the resistance most favourable for starting is found; once started, there is an arrangement which enables an axle in motion to act upon the mechanism which was before worked by hand. In this way the short circuiting of the bar can be quickly effected. If it is necessary to release the bar the motion is reversed.

We noticed that no shock was felt when passing over the stator.

The brake action and the changing of speed were most interesting. We stopped without any jerk being felt; the direction was changed almost *without stopping*—at least, that was the impression of those with us in the car!

We saw one of the interrupting motors working for an hour. Its action is very regular. The interrupting apparatus is simple and strong, and therefore safe.

M. Dulait had still more to show us. He ordered stones and earth to be thrown on to a stator. A compressed air appliance sent them all off as soon as the car arrived at the stator. We should have liked to see the experiment repeated with pieces of magnetic metal, iron, for instance, for we do not think that compressed air would answer in this case, as they would be attracted and held in place by the attraction of the stator. This contingency might, however, be provided against by placing a mechanical arrangement of the snow-plough type in front of the propeller.

M. Rosenfeld then gave an illustration of tangential traction on a small scale. Placing a cylinder of copper on a stator, he rolled it backwards and forwards just as the cars had travelled previously.

It was the general opinion with the reservation of certain objections as to points of detail, that, judging by the experiments that had been witnessed, tangential traction seems to be a practicable system as regards electric traction for railways; at present, at any rate, it is not proposed to apply this mode of traction to tramways.

The following are the principal advantages of this system, which enables us to attain any speed required, since the speed is only limited by the solidity of the rolling stock. The motor is replaced by a bundle of sheet-iron and a few fixed wires; there is no transformation of rotary motion into forward motion; no complicated arrangement of gearing; no reaction of the wheel on the rail in a direction opposite to that of the car; no skidding; little dead weight; the power produced serves directly for the propulsion of the system, the efficiency being considerable. Besides these advantages, there is one on which M. Dulait lays special stress; it is that *whatever may be* the pressure of the current—50,000 volts if necessary—this current is sent directly into the stators without the intervention of transforming sub-stations. Such a statement must, of course, be received with reserve. In this connection the representative of Messrs. Siemens & Halske reminded us that in the Zossen experiment a current of 12,000 volts was sent directly to the car. This is true, but could it have been done with 30,000, 40,000 or 50,000 volts? And even if it could, would not special and very irksome precautions be necessary? Whereas, according to M. Dulait, he has only half a volt on his car.

Lastly, M. Dulait drew the attention of his visitors to the experimental fact that with his system the influence on the telegraph and telephone circuits would be *nil*.

The writer of this article remarked that at Valtellina the fact of the third phase being connected with the rail had given rise to certain disturbances which had rendered it necessary to *double* the telegraph circuits. Several of the visitors were interested to hear that he had found a means of transporting industrial currents by using the earth as a return conductor without interfering with telegraph and telephone circuits having earth connections in the neighbourhood; and that at Valtellina it had been found out, although too late, that the disturbances could be suppressed by connecting the telegraph instruments to earth plates buried at a depth of 20, 30 or more metres. The explanation of this phenomenon is very simple. Alternating currents only affect the *surface* of a conductor more or less, *i.e.*, the earth in the present case. Thus, by sinking the earth plates to a sufficient depth, these inconvenient disturbances can be avoided.

Tangential traction has yet another special advantage. Whatever may be the tension used, the danger is nil, as the conductors and the stators are buried in the earth. One of the inventors told me that the experiments in tangential traction have, up to the present, cost about 1,000,000 fr., and I was informed by one of the most important shareholders that the promoters of tangential traction have applied for the concession of the Manchester—Liverpool express railway to be worked jointly with the Behr mono-rail!

A line of 50 km., constructed for a speed of 150 km. per hour—a speed, we may remark, *en passant*, realised by motorists in the Paris—Madrid race, but at the cost of their lives!—would cost 19,500,000 fr., and would have a total efficiency of 68 per cent.

I think I have clearly shown that tangential traction, which has been honoured by a learned society with the award of the much-contested Ferraris prize, solves the great problem of the age—"how to travel quickly, safely and economically."

I think, moreover, that it will be impossible to find an

engineer who can conscientiously affirm, or, at any rate, satisfactorily prove, that this beautiful application of the discovery of the revolving field that really constitutes tangential traction—which, in fact, is nothing more than a Ferraris motor with the radius of the earth for its radius—does not leave far behind all the existing systems of electrical traction, whether with one, two or three rails, whether worked by single, diphase, or triphase currents, by means of conduits, trolley blocks, in fact, any other system whatever.

[While we admire the invention described above, we are obliged to dissociate ourselves from the very optimistic views of our esteemed contributor, as we by no means share in his opinion of the commercial and technical practicability of the scheme.—Eds. Elec. Rev.]

HULL MUNICIPAL TELEPHONE SCHEME.

The Local Government Board inquiry into the application of the Hull City Corporation for sanction to borrow £47,350 for the purpose of establishing a municipal telephone system was commenced at the Town Hall on 26th ult. before Colonel W. R. Slacke, R.E., the Inspector appointed for the purpose. The inquiry occasioned a great deal of interest, and the Council Chamber, in which the proceedings took place, was crowded. The following report is abstracted from the very complete account of the proceedings given in the *Eastern Morning News*.

The Town Clerk (Mr. E. Laverack) conducted the application. There also appeared in support Dr. H. Woodhouse, for a Hull ratepayers' committee, and Mr. Dixon, for the Hull and District Chamber of Trades.

Mr. E. Robb, solicitor, London and Tunbridge Wells, opposed on behalf of a large number of corporations, firms, and individuals, including the Hull Property Owners' Association, Reckitt & Sons, the *Eastern Morning and Hull News* Co., Thomas Wilson & Sons, Ltd., the North-Eastern Railway Co., and many others.

Dr. T. C. Jackson, in reply to the Inspector, said that he opposed on his own behalf as a ratepayer. Mr. J. Watson, a ratepayer, and Mr. C. Fisher, for the Burstwick Parish Council, also opposed.

The Town Clerk said that telephones first came within the scope of municipal action by the passing of the Telephones Act of 1899. That Act authorised municipalities on obtaining a licence from the Postmaster-General to provide municipal telephonic systems within their areas, and to borrow funds necessary for that purpose. The Act was passed to carry out certain recommendations of the Select Committee which was appointed to inquire and report as to whether telephonic service was, or was not, calculated to become of such general benefit as to justify its being undertaken by municipal and other local authorities. The declared policy of Parliament in passing the Act was to enable municipal authorities, in the interests of the public, to take up the business in order to render the telephonic service more general and more efficient. At that time there were—and still were—two systems in Hull: the Post Office system and the National Telephone system. Although the Post Office were the first in the field at Hull, and were not followed by the Telephone Co. for some two or three years afterwards, their system gradually shrunk and dwindled until at the time to which he was alluding, it consisted, he believed, of under 30 subscribers, and these generally kept to that system because their calls were mainly on the trunk lines. The Act was passed on August 9th, 1899, and at once pressure was put upon the Hull Corporation to take advantage of it and provide a municipal telephonic system. The town clerk then detailed the proceedings of the Corporation which led up to the application for a license. They consulted Mr. Bennett, who in 1901 furnished a report upon two systems, one of 2,000 lines and the other of 3,000 lines. He suggested there should be three charges — one of £5 17s. 6d. a year for an unlimited rate, one of £3 10s. toll rate with ½d. per call for every originated call, and one of £2 10s. toll rate with 1d. per call originated. He estimated upon that they would have an average revenue of £5 5s. per subscriber, and upon that he anticipated a profit of £314 on a 2,000-line system. The estimated capital outlay for 2,000 subscribers, with 600 "spares," was £42,060, and for 3,000 lines, with 1,000 "spares," Mr. Bennett gave it as £63,800. Whilst they had every confidence in Mr. Bennett's figures, they preferred to be on the safe side, and therefore they fixed their flat rate, or unlimited system, at £6 6s. and determined upon one toll rate of £3, with 1d. per originated call, at which figures they were satisfied that the system would not be any burden on the rates. As a result of a circular they sent out, they obtained 1,167 promises to become subscribers, and it was somewhat material to observe that 871 of that number were for the unlimited rate, and 296 for the toll rate. The Corporation next considered the period for which they should take the license, and they determined upon 1911, the year in which the license of the National Telephone Co. would expire. Under the Act of 1899, if the Corporation obtained a license for a longer period than 1911, the National Telephone Co., upon agreeing to come under certain conditions, were entitled to have their license extended for the same period. They were desirous, above all things, that the license of the National Telephone Co. should not be extended beyond 1911, and they were quite prepared to run the risk of their own license being extended or not, especially as the Post Office had undertaken to purchase their system in 1911 if they took over the service.

Mr. Robb: Pardon me.

The Town Clerk: That is so. Before they did apply for the license they took the opinion of the Local Government Board whether, if they took it to 1911, they would have to repay the money in that period, as it would involve a heavy sinking fund, and they replied that they had decided to allow a period of 25 years, whether the license was taken to the year 1911 or later. The license was granted in 1902, and in order to be perfectly safe, they submitted their specifications to the Postmaster-General direct, and received his approval of them; therefore they might reasonably expect that, even if the Post Office were to take over the system in 1911, with the sinking fund which would be provided, and the amount which they would receive for their plant, kept up and maintained, as it would be, in a suitable condition, would recoup them for the capital outlay. Their specifications were ready for issue when what he might call the Tunbridge Wells fiasco occurred. Some people took alarm. The Corporation went over to Tunbridge Wells, and the result of their interviews with both sides was that Tunbridge Wells was about the last place where a remunerative telephone service could be established. The conditions there were different totally from those in Hull, and, with the exception of one gentleman, who made a minority report, the conclusion was come to that Tunbridge Wells was no guide whatever. Up to that point there was really no opposition to the scheme of the Corporation. In fact, they seemed to have the approval of the great bulk, at any rate, of the community. After the Tunbridge Wells episode there was some organised opposition, the result of which was seen in the opposition at that inquiry. The Town Clerk then explained the agreement with the National Telephone Co. with regard to inter-communication.

Mr. Robb asked if the agreement had actually been come to.

The Town Clerk: It has not yet been sealed.

Mr. Robb asked if the cost of the junction of the two systems was provided in the estimates.

The Town Clerk said he did not think so; it was only a very small matter. Continuing, Mr. Laverack said he would not have been at all surprised, in view of the arrangement that had been come to with the Telephone Co., if his friends on the opposite side had said they were quite satisfied, and that there would be no opposition, considering the great point that had been made of the "want of inter-communication." He trusted that the inspector would see his way to report favourably on the scheme. The Government had encouraged the Corporation to take the matter up, and, in response to that call, they had provided what they believed would be a cheap and serviceable telephone service.

The Inspector: If you don't get your application, what will be the position of matters in the town?

The Town Clerk: It will remain in the hands of the Telephone Co.

Mr. Robb: Haven't special terms been offered?

The Inspector: Is that the alternative agreement? I haven't read it.

The Town Clerk said that if the Corporation were unsuccessful in obtaining the sanction of the loan, the company would not then offer them the alternative agreement; there was no reason why they should.

The Inspector: Has the question of purchase been considered? If there were only one system, and that the Corporation's, that would naturally be advantageous to the subscribers.

The Town Clerk: But then there would be no competition, the very thing which in the declared opinion of the Government is an objection.

Replying to a suggestion by the Inspector with respect to expert opinion on behalf of the National Telephone Co.,

The Town Clerk said that the National Telephone Co. were not represented at the inquiry.

Mr. Robb said that the opposition, for whom he appeared, held no brief at all for the National Telephone Co. They were merely opposing the scheme because they were convinced it was an unsound one, financially and practically. The Inspector had made a very valuable suggestion, and he made this offer to the Corporation. They had had no expert advice other than that of Mr. Bennett, the gentleman who was responsible for what had been described as the Tunbridge Wells fiasco, and if the Town Clerk would submit Mr. Bennett's estimates to the present Chief Engineer to the Post Office, or to Sir William Preece, the late Chief Engineer to the Post Office, and either of those gentlemen said that the estimates were such that the scheme could be carried out without any loss to the ratepayers, he had no doubt the matter might be arranged.

The Inspector: That is not the point at all.

Mr. Robb: But you suggested technical advice.

The Inspector said that he understood the National Telephone Co. was represented, and his suggestion was made in that belief.

The Town Clerk having completed his opening, called Mr. A. R. Bennett, who said that he was a member of the Institution of Electrical Engineers. He was the author of "The Telephone Systems of Continental Europe," and in 1877 he erected the first telephone line constructed in Great Britain, and also the first installation of the electric glow lamp, and the first electric tramway on the overhead trolley system. He was the author of a good many improvements in telephonic apparatus, and was the general manager and chief engineer to the Glasgow Corporation telephone department, and telephone engineer to Portsmouth, Swansea, Brighton and Guernsey. Formerly he was general manager and chief engineer

in Scotland and the north-west of England to the National Telephone Co. He had advised the Hull Corporation throughout, and he adhered substantially to the report he furnished in 1900.

Mr. Bennett gave detailed particulars of his estimate which provided for 2,070 lines, of which 1,920 would be in Hull itself. They proposed to lay eight junctions to the branch exchanges, and 24 to the Post Office, keeping 18 junctions in reserve. The mileage of the cable contracted for was 20 miles 239 yards and 1,260 yards of branches. There would be 27 large manholes, and 218 joint boxes or distributing points. In the centre part of the city the subscribers lay so thickly that in a great many cases it would be possible to dispense with overhead wires altogether, and to take the cables into the subscribers' offices just as gas or water. Hull was also very lucky in this respect, that they could manage with two main routes for the outside area, one to the north and the other to the west. The system would be laid out so that communications would be private, and could not be overheard, and there would be an entire absence of buzzing and whistling sounds which were frequently present in inferior telephone systems. The operators would not be able to hear the conversations for the purpose. He was quite satisfied that he had made sufficient provision for construction, and supported his statement by giving his actual experience in other towns. In Hull, the cost of construction—apart from the cost of alterations—averaged almost exactly £20 per line; that was according to tenders. In his first estimate to the Council he allowed for £20 6s. 4d. In Portsmouth, where the municipal exchange had been working some five or six months, he estimated to that Corporation that the average cost would be £21 8s. 9d., but the work had been completed for £20 10s. 4d. At Guernsey, where there was a large exchange at work, the actual cost of the telephonic work had averaged £17 11s. 4d. per line. His Hull estimate of £20 included both the lines and spare lines. As to the working expenses, he adhered to what he had said in his report. He had been very liberal in estimating the working expenses for Hull, which, including depreciation, he had averaged at £5 5s. per line. The average working cost in Glasgow per annum had been £3 13s. per line, in Guernsey £3 2s., and in Portsmouth it would be about £3 9s. 11½d.; so that they would see that in putting the average for Hull at £5 5s. he had provided very liberally indeed.

The witness was cross-examined as to the extension lines, the cost of which is £10, and the estimated number of which was put by Mr. Robb at 160. Where, he was asked, had he provided £1,600 for those extension lines? He replied that if extension orders were received, they would use up some of the instruments they had provided for, and if additional direct lines were ordered, they would have to buy more instruments, and that would mean more revenue than they provided for.

Mr. Robb: That means you would have to rob your principal exchange line.

The witness was examined at length on several details of the Tunbridge Wells scheme, and was then questioned closely as to whether he had ever worked within his own estimates, and particularly in regard to his work at Tunbridge Wells.

Mr. Robb: Did you recommend a Joseph Chamberlain—(laughter)—a butler, to take the possession of this municipal scheme at Tunbridge Wells?—(renewed laughter).

Witness explained, amidst much amusement, that Joseph Chamberlain was a steward in the employment of some magnate in the neighbourhood of Tunbridge, and his special qualification was his intimate knowledge of everybody and everything connected with Tunbridge Wells—(laughter). His primary duty was to obtain in the first instance, subscribers and then wayleaves, until they got into as satisfactory a position as the Telephone Co. He was appointed assistant manager. He did not think it would have been a bad plan to make Mr. Chamberlain manager, if they had confined him to the business part of the undertaking. Of course, they must have in the chief electrician a technical man.

Mr. Robb: Have you a Joseph Chamberlain in view in Hull as a possible manager?—(laughter).

Further cross-examination took place on the details of the system proposed to be installed, Mr. Robb suggesting that it was already obsolete.

Mr. Bennett was then re-examined by the town clerk.

It was suggested to you yesterday by Mr. Robb that the estimate you have given as to the cost per line for construction is much too low, and that you had not carried it out in Glasgow?—That is not correct.

The witness explained that the extra cost at Glasgow was caused by the extra plant being laid for future use.

The Town Clerk: The question of depreciation is a very great question. There is considerable diversity of opinion as to whether anything at all should be put aside for depreciation in view of the sinking fund.

Mr. Bennett: Prominent authorities hold that a depreciation fund is only necessary where the sinking fund is not calculated to pay off the loan within the stated time.

Sir James Reckitt gave evidence against the scheme.

Mr. Robb asked Sir James what were the principal points of his opposition to the municipal telephone system. Witness replied that, as a man who had been in business 45 years, he considered the proposal of the Corporation was very bad business. It would be almost impossible to recoup the £50,000, or thereabouts, in the few years which were allotted for the purpose, and he had no hope that the Post Office were at all likely, at the end of the eight years, to give the Corporation back anything like the amount which the latter proposed to spend. His experience of the Post Office was that they were just and fair, but not generous.

I believe that the £50,000 will be largely sunk and lost by the year 1911, and the Post Office are not likely to refund anything like the amount. If the Corporation spend this money, it will be in the face of the knowledge that there is a possibility that they will not get it back, and the Post Office authorities well know that the Corporation has been warned that the probability is that they will not get the money back.

Major-General Webber, electrical engineer, and one of the founders and past presidents of the Institution of Electrical Engineers, was the next witness called. He had long been connected with telephonic work and developments, and for nine years he was engineer for the South of England Postal Telegraph Department. He had given evidence at similar inquiries. He had devoted special attention to telephonic work as regards local authorities.

Questioned by the town clerk, witness said that the telephonic system had not spread in this country as it might have done, and as it had done in other countries. The commercial policy of telephone companies had been to place the telephones at the disposal of those who could pay the highest rates. He was of opinion that competition with the National Telephone Co. could be undertaken by the Hull Corporation with success, and that there would be no burden cast upon the ratepayers.

Questioned as to Mr. Bennett's estimates, witness said that he approved of them, with one exception. Mr. Bennett, he thought, had made, with one exception, due allowance for all work to be done. Especially were the specifications for the underground work drawn on lines that were likely to ensure the most satisfactory results. Mr. Bennett's estimate also made ample provision for all contingencies.

The Town Clerk: Are you of opinion that the total amount for which we are applying will not be exceeded?—That is my opinion, providing the designs and specifications already made are adhered to.

In reply to other questions, Major-General Webber said he regarded the scheme as a good and judicious one, well laid out, and laid out so as to be capable of very large extension. If, in 1911, the Post Office decided to purchase the system, they would have to carry it on from the very hour they took it over.

Mr. Robb here spent much time in cross-examining witness with regard to the ring-through system, and asked if that system were in operation at Paris.

The reply was to the effect that they did wonderful things on the telephone at Paris. They even called up subscribers by their Christian names.

Asked if he would not give the subscriber as little as possible to do, witness replied, "Certainly not. That is the whole fallacy of the telephone question."

The Inspector: I have to consider the probability of a war of rates arising. The company might possibly proceed to cut the rates so as to bring down the Corporation. Of course that is highly improbable, but it is possible, and we must look into the future in that respect. Do you think that the agreement should be so framed so as to prevent a war of rates?

The reply was to the effect that it would be wise not to seal an agreement without provision being made that there should be no war of rates.

Mr. Arthur Wilson, J.P., gave evidence in opposition to the scheme.

Witness said that he was a Deputy-Lieutenant of the County, and one of the largest owners in the firm of Thomas Wilson, Sons, and Co., who were very large shipowners, and directly and indirectly one of the largest employers of labour in Hull. He objected to the scheme of the Corporation, and his principal reasons were that he thought there was no doubt at all that it would not be a paying scheme. "They say," continued witness, "that there will be inter-communication. Well, what does that mean? It means delay, and when you use a telephone you want it to be as rapid as you can." More important than that, however, was the cost. As a business man, he believed no one would feel inclined to go into this concern if it were a company.

If this were a private company would it attract private capital?—Most certainly not. Nobody would ever subscribe 1s. to it. I think it is the height of folly to go on with the scheme.

By the Town Clerk: When his firm signed a request for a municipal service in 1899, they were dissatisfied with what the National Telephone Co. were doing for them. But now it was an absolutely perfect service.

But you know you induced us to take this matter up?—There is plenty of time to stop it.

Councillor Brown, chairman of the Telephone Committee, was then called as a witness for the Corporation, and gave particulars of the proceedings of the Committee.

Mr. James Farrell, chairman of the Hull Ratepayers' Telephone Committee, was afterwards called. He said, in reply to Dr. Woodhouse, that he represented the traders and ratepayers in the city, most of whom were substantial ratepayers. The Committee had every confidence in the scheme, and thought it would be efficient. Before the Corporation scheme was brought forward, the present system in Hull was most unsatisfactory, and it was only then that the Telephone Co. had shown any disposition to meet the requirements of their subscribers.

Mr. S. T. Nicholson, the secretary of the Hull and District Chamber of Trades, called by Mr. Dixon, said that that body had 1,200 affiliated members and subscribers, who were drawn chiefly from the retail traders, and he estimated their total rateable assessment at £100,000. The Chamber took up the matter of a municipal telephone in November, 1898, because of the prohibitive charge of the National Telephone Co. They made a canvass of the commercial people of the city, and received about 1,000 signatures to the petition, which was afterwards presented to the Council. A deputation also waited upon the late Mr. Hanbury, whose reply was most favourable.

Cross-examined by Mr. Robb, the witness said that his firm was afterwards employed by the Telephone Committee to canvass for subscribers, but he declined to say what proportion of the 2s.

per subscriber obtained, they paid to the sub-canvassers employed. When his firm was first asked to undertake the work, they declined to do so, but a personal request was made to them by the chairman of the Telephone Committee, and he consented. He saw the leading shipowners and traders personally.

On the conclusion of the evidence in support of the application, Mr. Robb called

Colonel H. F. Pudsey, J.P., who said that he was the chairman of the Hull Property Owners' Protection Association, the membership of which was 305. At a meeting held on April 27th a resolution was passed expressing the Association's absolute opposition to the establishment of a municipal telephone exchange. They opposed the scheme because they thought it would result in a charge being made upon the rates. The estimated profit was only £315, and that amount was about to be given away to the National Telephone Co. by the reduction of the wayleaves. His Association and himself felt it would be a great mistake to expend £44,000 upon the strength of a license which they might have to relinquish in 1911, and they strongly objected to charging the rates for 25 years for such a scheme. He thought that the undertaking would start severely handicapped by the opposition of such firms as Messrs. Thomas Wilson, Sons & Co. and Messrs. Reckitt & Sons. His Association represented a rateable value of £30,000.

The Town Clerk cross-examined the witness to show that he had overstated the rateable value represented by a deputation referred to.

Cross-examined by Mr. Dixon, Colonel Pudsey said that his own property in Hull amounted to over £9,000.

(To be continued.)

BOARD OF TRADE AND ELECTRIC CAR CONSTRUCTION.

The Council of the Tramways and Light Railways Association recently invited remarks from its members on the following recommendations, it being proposed to address the Board thereon :—

Board of Trade,
(Railway Department),
7, Whitehall Gardens, London, S.W.
July 29th, 1903.

Sir,—I am directed by the Board of Trade to transmit herewith a copy of a letter which has been addressed to the promoters of tramways and light railways authorised to be laid on public roads, embodying certain criticisms which have been offered by the inspecting officers of railways and the electrical adviser of this Department on points relating to the construction and equipment of electric cars.

I am to add that the Board would be glad to receive any observations which you may desire to make on the matters in question.

I am, Sir, your obedient servant,
Herbert Jekyll.

The Secretary, Tramways and Light Railways Association.

I am directed by the Board of Trade to state that they desire to draw attention to the following criticisms which have been offered by their inspecting officers of railways and their electrical adviser on certain points relating to the construction and equipment of electric cars for tramways and light railways laid on public roads :—

1. *Folding Steps.*—The efficiency of the life-guard is often impaired by the steps, which are liable to strike a person falling in front of the car before the lifeguard can come into action. It is suggested, therefore, that the steps should be so designed as to fold up, and that they should invariably be folded at the front end of the car.

2. *Reversed Staircases.*—These staircases have the disadvantage of limiting the view of the motorman and of restricting his movements.

3. *Trigger Lifeguard.*—The distance between the hanging gate and the lifeguard proper should be about 3 ft. in order to allow time for the guard to drop before it meets the object to be picked up. In some cases the distance has been only 1 ft. 10 in., which is not enough to make the guard effective.

4. *Trolley Ropes.*—Several accidents have been caused by the slack of trolley ropes and by the handling of trolley ropes by passengers. On many tramways the trolley ropes are kept tied up, and in some no rope is used. For centre-running trolleys, or for swivel trolleys with a small reach, spring winches are useful for taking up the slack and for preventing the trolley from jumping. For swivel trolleys with a wide reach the slack may be taken by providing a weight like a sash weight at the end of the rope and putting this into an upright pipe with a bell mouth. The "nursing" of the trolley by the conductor is an admission of defective adjustment of the overhead work.

5. *Adjustable Stop on Trolley Standard.*—On many tramways it has been found practicable to adjust the screw stop so as to limit the rise of the boom if the trolley leaves the wire. It is desirable to adjust the height of the trolley wire and guard wires so that advantage may be taken by this limitation, to prevent damage to overhead work. Where there is no adjustable stop, the rise of the boom may be prevented by limiting the play of the trolley rope except in the case of swivel trolleys with considerable reach.

6. *Trolley Heads.*—Several cases of injuries to passengers by falling trolley heads have occurred. Although it is very desirable that, in the event of a trolley head catching in a switch or other overhead "trap" the head should become detached rather than that the boom should be pulled out or the standard broken, care should be taken that the boom is long enough to ensure that the trolley head may drop clear in the wake of the car.

7. *Trolley Booms.*—Several accidents have occurred through the pulling out of trolley booms. The attachment by pinching up a split casting appears to be unsatisfactory since insulating material is used and a tight grip cannot be ensured. A half sleeve with four bolts or some other attachment is preferable.

8. *Breakage of Trolley Standards.*—When a trolley head catches and neither the head nor the boom give way, serious injury to passengers has been caused by the breaking or tearing up of the standard. Overhead "traps" should be avoided as much as possible. Anchoring of trolley wires in bracket construction should be avoided by anchoring in a vertical plane to a standard on the bracket, or if the bracket needs anchoring, that should be anchored and not the trolley wire.

The Board would be glad to learn whether you, or the body which you represent, concur in the foregoing criticisms, and will be prepared to take steps to meet them as regards new cars, and as far as practicable, with regard to cars now in use or under construction. Should you not be able to concur on any point, the board will be glad to be furnished with any observations that you may desire to offer on the matters in question.—I am, your obedient servant,

Herbert Jekyll.

THE BERLIN UNDERGROUND RAILWAY AND THE PARIS DISASTER.

A Government Inquiry Leads to Considerable Improvements.

One of the immediate results of the recent disaster on the Paris Metropolitan Railway is to be found in the investigation which the German Government has caused to be made of the position of affairs obtaining on the Berlin Elevated and Underground Electric Railway, with a view to the prevention of a similar accident on that line, or rather on the low level portion of the railway. The inquiry, which has taken the form of conferences and an inspection of the railway, was opened on August 17th, in the large hall of the Potsdam Railway Station, under the chairmanship of Councillor Behrendt, President of the Berlin State Railway Administration. It was attended by other representatives of the Government, and of the police and fire brigade, by Herr Schwieger and Herr Lerche, of the Siemens & Halske Co., the builders of the railway, and by Herr Paval, and Herren Schulz and Burchard, manager and engineers respectively of the Elevated Electric Railway Co.

The question of the fire in the Paris tunnel between Les Couronnes and Ménilmontant first engaged attention. It was submitted that the depth and length of the Paris northern circle (about 6¾ miles), together with the joint entrance and exit, render the ventilation of the tunnel uncommonly difficult. In the case, however, of the tunnel section of the Berlin elevated railway, the condition of the air is different, as each train produces a fresh movement of the air, which finds a ready means of discharge at the stations. The length of the tunnel section, which is situated between the Nollendorf Platz and Knie, is slightly over 1¾ miles. The production of smoke to the extent which obtained so fatally in Paris is therefore considered to be out of the question on the Berlin railway, even if the rolling stock were less fireproof than is actually the case. In addition to this, if a fire occurred in a car at a station it would be speedily extinguished by the hydrants which are available, and a train can cover the distance along the section to the station in two minutes at the longest. As far as illumination is concerned, it was pointed out that as compared with the single staircase in Paris, the Berlin stations are provided with convenient entrances and exits in both directions, both being well lighted at night, and that, too, from cables which are independent of the feeders for the operation of the railway.

The conference was resumed on the following day, and an official report was published at the conclusion of the proceedings, which were initiated by the Minister of Public Works. As a result of the inquiry, the report states that the structural works, the rolling stock and the equipment of the underground railway are arranged very differently from the Paris line, and without doubt an accident similar to that on the latter railway seems at least very improbable on the Berlin railway, if it is not out of the question. The entrances and exits in contradistinction to Paris, are capacious and sufficient, are conveniently accessible, and are lighted by daylight. The establishment of further exits at the other end of the platform does not, therefore, appear necessary. The lighting conductors in the tunnels and the stations of the underground section are independent of the cables for the working of the train service. In the method of construction and material used, the cars are so arranged that the ignition of them in the case of a short circuit appears out of the question, and therefore a dangerous development of smoke is

not to be apprehended, especially as the cars are covered with sheet iron. As a further advance in public safety, it is proposed to materially increase the lighting of the tunnel, so that even in the event of the complete extinction of the lamps inside the cars in consequence of an interruption in the working, there will still be adequate illumination for any case that may arise. This tunnel installation is to be protected in a higher degree from external influences, as its faultless condition will afford the best guarantee for the safe emptying of the cars in case of danger.

The official report proceeds to state that in order to render it possible for passengers to leave the cars and reach the next station in the tunnel without any danger, arrangements are to be made whereby each official accompanying a train will be able to immediately switch off the working current at any point in the tunnel. By this means also the approach of trains on the other track will be made impossible, and any danger of contact with the rails will be obviated. It is also proposed to arrange for the porter's barrier at the platform exit being easily pushed on one side, and to increase and improve the existing fire extinguishing appliances. In addition to these proposals, experiments are to be made to ascertain whether the establishment of air shafts with extractors would render it possible in case of necessity to remove smoke and afford quicker access to the permanent way for the fire brigade and others desirous of affording assistance, and whether the arrangements for a rapid clearance of the passengers from the cars are capable of improvement. The existing regulations governing the railway employés are to be amplified with a view to coping more successfully with any case of emergency, whilst a short intimation is also to be published for the information of the public as to the attitude to be observed by passengers in the event of an accident occurring on the railway.

THE HEAT ABSORBED IN THE ELECTROLYSIS OF SALTS AND THE PRINCIPLE OF THE MAXIMUM WORK.

By DR. D. TOMMASI.

1. It is known* that if we electrolyse a solution containing 1 molecule of nitrate of silver, 1, 2, 4, 8, 16, 32 molecules of nitrate of copper and 100 molecules of water, the nitrate of copper does not begin to be decomposed until there is in the solution a little more than 30 $(NO^3)^2$ Cu for 2 NO^3 Ag.

By continuing to increase the proportion of nitrate of copper, we at last arrive at a point at which the deposit contains, for one atom of copper, two atoms of silver.

When the solution contains two molecules of nitrate of silver to 87 molecules of nitrate of copper, we get, as a product of electrolysis, one atom of silver and one atom of copper. Now, according to Sprague's law,† which is the reciprocal of the principle of the maximum work, it would be the nitrate of silver that would decompose first, and then the nitrate of copper, since the heat of decomposition of this compound (52·3 cal.)‡ is much higher than the heat of decomposition of the equivalent quantity of nitrate of silver (2 NO^3 Ag = 17·4 cal.),§ and yet we have just seen that the composition of the metallic deposit varied according to the proportion of nitrate of copper and nitrate of silver contained in the solution subjected to electrolysis.

2. According to the thermic data, a solution of chlorate of potassium being subjected to the simultaneous action of the electrolytic hydrogen and oxygen should undergo reduction rather than oxidation.

In fact, the reduction of the chlorate gives off:—

$$ClO^3K + 3H^2 = ClK + 3H^2O \quad \ldots \quad \ldots \quad 224{\cdot}4 \text{ cal.}$$

and its oxidation gives off:—

$$ClO^3K + O = ClO^4K \quad \ldots \quad \ldots \quad \ldots \quad 17{\cdot}6 \text{ cal.}$$

And yet experiment proves that the chlorate is transformed *into* perchlorate.

3. If we acidulate a solution of bioxide of hydrogen (H^2O^2) with sulphuric acid, we get at the negative pole a liberation of hydrogen, due to the decomposition of the water, but the reduction of the bioxide of hydrogen does not take place.

Now, how can we explain the fact that the electrolytic hydrogen which reduces a great number of substances, the composition of which absorbs heat, does not act upon bioxide of hydrogen, the decomposition of which, on the contrary, takes place with liberation of heat.

In other words, why does the electric current decompose water whose heat of decomposition is − 69 cal. rather than act upon bioxide of hydrogen, the heat of decomposition of which is + 21·6 cal.?

4. We observed ‖ a similar fact with the following couple:—

Zinc, acidulated water; porous jar, bioxide of hydrogen, with the addition of one drop of sulphate of copper in solution, Platinum.

In this couple, in fact, the deposit of copper on the platinum is produced as soon as the circuit is closed, and long before the bioxide of hydrogen has been decomposed. We notice, then, in this couple the singular fact that the hydrogen produced by the decomposition of the water reduces the sulphate of copper (an exothermic compound), the decomposition of which consequently absorbs heat, in preference to the bioxide of hydrogen (an endothermic compound), the decomposition of which, on the contrary, takes place with liberation of heat.*

From these researches may be deduced the following laws:—(1) When a body is subjected to two chemical actions, the reaction which gives off the greatest quantity of heat will always be produced in preference, provided, that is, that it can be begun; (2) In the case of two chemical reactions, the one which requires the least heat or energy for its commencement will always be produced in preference even if it gives off less heat than the other reaction.

From what we have just said, it follows that the principle of maximum work is completely false, and that, therefore, it is desirable that it should be replaced by a new thermo-chemical principle more in accordance with actual experience.

This new principle, which we propose to call the *principle of minimum work*, might be enunciated as follows:—The chemical reaction that requires the least energy † for its commencement will always be produced in preference, whatever may be the quantity of heat that this reaction, when once begun, is capable of liberating or absorbing.

* See "Traité d'Electrochimie," by Dr. D. Tommasi, p. 25.

† The substances set at liberty at the electrodes are those which, in freeing themselves, absorb the least specific energy.

‡ Heat of formation calculated according to D. Tommasi's law of thermic constants.

§ Heat of formation calculated according to Tommasi's law of thermic constants.

‖ "Traité d'Electrochimie," by D. Tommasi, p. 476.

SOUTH AFRICAN NOTES.

(From our Johannesburg Correspondent.)

Mowbray.—The Lighting Committee of the Mowbray Town Council recently recommended the acceptance of an offer from the Cape Peninsula Lighting Co. for the electric lighting of the town on a 15 years' basis.

Queenstown.—After months of waiting, the consent of the Government has been obtained for the Queenstown electric lighting scheme. The erection of the plant will be proceeded with immediately, and by the end of the year it is hoped to have the installation complete.

Potchefstroom, Transvaal.—"Developments" are expected shortly in connection with the electric lighting of this, the former capital of the Transvaal. It has already been reported in the Electrical Review how urgently an efficient lighting service was needed for this, as well as for many other Rand townships. Agitation went on for some time, but the Health Board could not, and the Government would not, move in the matter, the subject being brought up for discussion time after time, and as often "shelved." Thereupon some of the larger property owners took steps to instal small plant of their own, and, as reported under date June 15th, a private company was formed to supply electricity for light and power purposes for the whole town. Some of the members of the Health Board, having the welfare of the town at heart, then sent a deputation to the Colonial Office in Pretoria, which resulted in success. The Government electrician, Mr. Stevens, was sent to Potchefstroom to draw up a scheme, and the Government have decided, pending the formation of a proper municipal council, to undertake the scheme for the benefit of the township, and in the meantime will offer no facilities to any private company regarding the erection of lines, &c. This would appear to be the death blow of the "Potchefstroom Consumers' Electric Light and Power Co.," but they have expressed their intention of going on with their scheme. As the success of the company so much depends upon Government support, although it is obviously "hard lines," they will probably eventually have to climb down. A compromise would be the fairest settlement, the company putting down plant, &c, and carrying out wiring contracts, which will probably be agreed to.

Metric System.—In the Cape House of Assembly, Mr. Amos Bailey, M.L.A., directed the attention of the Government towards the adoption of the metric system as the standard of weights, measures and coinage for the Colony, and the Prime Minister will, at an early date, enter into negotiations with the Imperial Government for that purpose.

The Somerset West Tramway Bill has been read and passed for the third time.

Pietermaritzburg.—The Natal Government railways electrical department is calling for tenders for additional plant for the power station at Pietermaritzburg. The tender of Callender's Cable Co. for £3,141 10s. 5d. has been accepted by Messrs. Mordey & Dawbarn on behalf of the Town Council. The following items occur in the borough engineer's report for June:—Building extensions at the power station are almost finished; excavations for the new 240 KW. sets are completed, and templates are being prepared. A second Weir pump has been erected, and the foundations for the No. 6 set of boilers completed. 1,784 ft. of cable have been laid, including 543 ft. of H.T. The revenue during the month was £2,305 10s. 6d., an increase of £250 9s. 1d. over the corresponding period last year.

Durban.—The manager of telephones in his report to the Town Council says:—The total number of subscribers up to July 31st stands at 841, an increase of 243 since the concern was purchased from the Natal Telephone Co. in December, 1901.

* "Traité d'Electrochimie," by D. Tommasi, p. 526.

† Calorific, luminous, electric, &c.

From the tramway manager's report we learn that there are now 18 miles of track open, 33 cars being in daily use.

Transvaal.—Much dissatisfaction has been expressed recently at the condition of the Johannesburg—Delagoa Bay telegraph system, or lack of system, the Chambers of Commerce in both centres giving voice to public opinion. The defect, it appears, is on the Transvaal side of Komati Poort, and a complete reconstruction of the line from Johannesburg to that point is being undertaken, and is expected to be finished shortly, when, it is hoped, an uninterrupted service will be obtained.

The standholders of Turffontein and Forrest Hill, emulating their Ophirton neighbours, have decided, at a public meeting, to petition the Town Council to extend the proposed electric tramway system to their suburb, agreeing to a special rate to cover loss on working.

Mr. McBean, who has just resigned the position of chief electrician to the East Rand Proprietary Mines, was the recipient of warm thanks (and a purse of gold) from the Boksburg Health Board at a special meeting convened for that purpose. Mr. McBean has been the honorary advisory electrician to the Board in connection with the new electric lighting contract.

Lourenço Marques.—A number of cars for the L.M. electric tramways have now arrived. The laying of the track has been nearly completed in the principal avenues.

LEGAL.

Carnaby *v.* Neale and the South-Western Electrical Co., Ltd.

Before Mr. Justice Walton, sitting as Vacation Judge on August 27th, Mr. Bramwell Davis, K.C., in this partnership action, moved for the appointment of a receiver and manager of the business of electrical engineers carried on at Palace Terrace, Fulham. It appeared that Mr. Carnaby and Mr. Neale entered into partnership on September 1st, 1902, and that £500 capital was found by Mr. Carnaby. On May 31st last there was a profit of £202 on the nine months' working, but the partnership was crippled for the want of money, and Mr. Carnaby advanced a further sum of £300. Since then the business had been formed into a company, but Mr. Carnaby had not had his money returned. He had been forcibly ejected from the premises by Neale, and, as he could get no satisfaction, he asked for the appointment of a receiver.

Mr. Douglas, on behalf of the defendants, said the new company admitted its liability to Mr. Carnaby as to the £300, and offered to give him an indemnity for that amount.

On this understanding the motion was adjourned until the next sittings.

Wells *v.* The Stewart Electrical Syndicate, Ltd.

Before Mr. Justice Walton in the Vacation Court on August 26th, this matter came up on the application of the plaintiff, who is a debenture holder, for the appointment of Mr. G. S. Pitt, the liquidator of the syndicate, as receiver and manager in the voluntary liquidation on behalf of the debenture holders.

Mr. Galbraith, in support of the motion, said he was in a position to treat the motion as the trial of the action. He asked his Lordship to make an order in the terms of the agreed minutes. The syndicate agreed to the appointment of Mr. Pitt as receiver and manager on behalf of the debenture holders. He also asked, with the consent of the syndicate, that the plaintiff and the other holders of debenture bonds should be entitled to a declaration of charge. The gentleman who had been appointed liquidator, and also now the receiver and manager, consented to the order.

His Lordship made the order asked for accordingly.

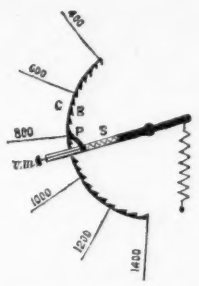
CORRESPONDENCE.

Faults on Mains.

Can any of your readers inform me as to what precautions are taken to prevent unnecessary damage to feeders, distributors, and occasionally pedestrians, when a short or fault occurs at periods of light load?

It seems to me the usual practice simply allows a certain margin above the normal full load capacity of the main or mains, being generated before the circuit opens. Take, for instance, a feeder 1 in. in cross-section with cut-out set for, say, 1,400 amperes. During the greater part of the day this feeder may have a load of only 200 or 300 amperes, or even less. If a fault develops under these conditions there will evidently be a margin of 1,100 or 1,200 amperes left to blow it out before the circuit opens. Considering the number of up-to-date appliances and methods of testing, this appears to be rather a crude way of treating faults and weak spots on mains.

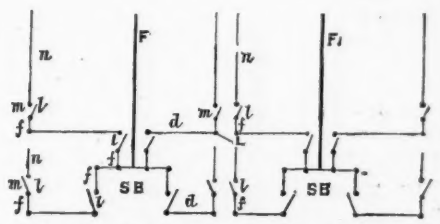
Is it not feasible to have an automatic cut-out switch fitted in each feeder, either for traction or lighting supply, which is capable of being rapidly adjusted by a simple movement, to allow only a safe margin under *all conditions of load?* The load on any station does not alter much from day to day, so that it would be an easy matter for a switchboard attendant to set all cut-outs to suit the load at different periods of the day. Some station engineers adopt the plan of using double fuses on their feeders, one set for half load and the other for full or overload. A throw-over link is fitted for the purpose of bridging either of them. This plan also presents an easy means of carrying an emergency load on any feeder should the network become disorganised through adjacent feeders being cut out.



R, P, Ratchet and pawl; *s*, Spiral spring inside lever; *t*, *s*, Tension spring for adjustment; *r*, *m*, Ramrod for disengaging pawl; *c*, Calibrated scale.

A circuit breaker fitted with a variable adjustment somewhat similar to the above sketch would, I believe, be an acceptable type in central stations. To prove its utility, each feeder on a lighting system should feed its own section only, this section being isolated from the rest of the network, and provision made for linking one or more sections on to different feeders if required.

In addition to this, the feeder should only have a cut-out at the station end, the fuses at feeding points being placed on distributors, and each distributor feeding its own network, thus:—



F, Feeder; S, B, Street box; *m*, Section manhole; *d*, Distributor; *n*, Network; *f*, Fuse; *l*, Link (disconnecting may be combined with fuse). L, Interconnecting link.

Tramway practice, at present, fulfills these conditions, with the exception of a cut-out capable of simple and rapid adjustment that can be altered with safety *while carrying load.*

I have recollections of a large lighting system that, until quite recently, was tied up with the object of blowing out all faults, thereby saving the mains' engineer the head-splitting worry of finding them, and probably damaging yards of mains by fire and *water.*

An interchange of views on distributing difficulties and means for overcoming them would be appreciated by a large section of your readers.

J. C. Stewart.

Island of Arran, *September 1st*, 1903.

Switchman or Premium Pupil?

I heartily endorse the sentiments expressed by "10,000 Volts," but I think that the matter is to be explained in this manner—that as long as we have "gentlemen's sons" who have not the moral courage to demand a reasonable figure for their services, so long shall we have the "nominal salary."

E

I passed through the switchman period three years ago, and even then I found the evil rampant.

To cite one instance in my experience of central station work: the switchmen were placed on a sliding scale—viz., 5s. first year, 7s. 6d. second year, and 10s. the third year! I wonder how many would care to remain till the third year? I consider that these appointments are made by men who have been "jumped" into a responsible position, and who have not had to undergo the tedium and confining duties of a switchman. The case I mention had its own reward—repeated mistakes; and, consequently, the item "repairs to instruments" was considerable.

It is to be hoped that the time is not far off when a reasonable figure will be paid to all assistants, and that those who are responsible will forego this idiotic policy.

P. P.

Electric Drills.

I have read the letter under the signature of the Sandycroft Foundry Co., Ltd., in the current number of your journal.

In taking up the manufacture of the solenoid type of drill, I am afraid they are making a mistake, as this type, both in Germany and America, has had to be generally abandoned; and on their own showing it takes *half* the energy required by an air drill, whilst other electric drills take very much less than this.

It is, however, the last paragraph of their letter, and the last sentence in that paragraph, to which I wish to take exception. Such statements as these by manufacturers and contractors of electrical machinery have caused most of the trouble with regard to the use of electrical machinery in mining by allowing users of such machinery to infer that it "goes by itself," so to speak, and that no skilled, and in some cases not even *any*, attention is required. This is a great mistake. Because one, by merely pulling over a handle, may cause a motor to easily and sweetly revolve in its self-oiling bearings, it does not do to think it requires no attention; by turning the steam on to a steam engine it will do the same, and the self-oiling bearings can be equally applied to it, but no owner of a steam engine would expect it to go by itself, or think that it required only the services of an unskilled labourer. Why then should electrical engineering be reduced to the rank of "unskilled labouring"?

Electricity is a form of energy, and as such ought to be intelligently controlled, and the sooner this is recognised the better for everyone. Economy in the use of electricity should not be expected so much from getting rid of the skilled labourer as from the saving of energy lost in transmitting the power, and the many other advantages it may possess for the particular purpose to which it may be applied.

T. Campbell Futers.

Wanted: An Efficient Commercial Incandescent Lamp.

I am obliged by the details furnished by the Electrical Co., Ltd., as to the superiority and saving in ultimate cost of current of the Nernst lamp, most of which, or, perhaps, similar facts, have been published before in the company's trade circulars. Unfortunately, I find, in conversation with electrical contractors, that the large initial cost of the installation of the Nernst lamp does prevent its adoption, the majority of would-be consumers speedily deciding against it when the relative cost of wiring with Nernst lamps, or with the ordinary incandescent, is put before them; and this in spite of a less number of Nernsts being required. When all is said and done, several lights of small candle-power scattered about, rather than a few of large candle-power, give the best lighting effect; and, although the company state that they have overcome the sensitiveness to changes of voltage, from my experience with the last batch recently received, I am afraid that the filament is still somewhat wanting. At the same time, we all welcome the advent of the Nernst as a move in the right direction, and hope to see it improved in the direction of greater strength, cheapness, and smaller candle-power.

The remarks of Councillor Kennedy, of Glasgow, at the recent M.E.A. Convention, on the comparison of the light given by incandescent electric lamps and incandescent gas mantles, very much, I am sorry to note, to the disadvantage of the former, show that the question of the inefficiency in light-giving power of the first-named, in proportion to their relative costs, is becoming a question that will have to be seriously considered ere long.

I should like to hear the experience of some of my fellow assistants who come in contact with this phase of our industry, and more particularly hope to hear from the lamp makers that something is on the way which will help us to make headway against our powerful competitor.

H. H. M., *Assistant Engineer.*

August 31st, 1903.

English Porcelain Insulators.

A portion of the daily press has, during the past 10 years, educated the British public; the result has been that the educated firmly believe that all British manufacturers are rapacious, idle, densely ignorant, incapable of enterprise, and that they refuse to allow science to help them to earn their living. Granting this, one can readily understand that Mr. Garrard's statements about English-made insulators in his article on "Overhead Transmission" in your issue of August 14th will readily be believed. Surely your contributor cannot seriously think that English porcelain insulators are used in this country because glass ones cannot be made? Glass insulators were tried in the early days of telegraphy, but their use was given up, as they were found to be distinctly inferior to pot insulators. The use of the glass insulators in America obtains solely on account of their cheapness.

Perhaps Mr. Garrard has never travelled through France, and seen the flimsy telegraph line construction along the railways—light cross-arms, glass insulators, and construction which would not be tolerated in this country.

The glassy nature of foreign-made insulators is a drawback, not an advantage. The material is brittle, and cannot be threaded internally; consequently the stalk has to be cemented into these insulators instead of being screwed in, as is done with English ones.

Now, when Mr. Garrard speaks of English insulators depending upon their glaze for their insulating properties, he shows he knows nothing of the process of their manufacture. Each insulator, after being dipped, is placed in the kiln, upon three thimbles, upon which it rests during firing. The places where its rests on the thimbles are never glazed, consequently glaze has nothing to do with the insulation. As a matter of fact, the articles are only glazed in order to keep them clean.

It would be well to know whether Mr. Garrard has, or could, make comparative tests of English and foreign-made insulators? If so, he should publish particulars, and show engineers what the truth is.

Meanwhile, it would be well to remember that this journal is read all over the world, and users now have its authority for believing that British-made insulators are inferior. The policy of crying stinking fish is sure to bear its natural fruit in time to the detriment of manufacturers and their workpeople.

W. Rooper.

Stafford.

The article by Mr. C. C. Garrard in your issue of the 14th inst. is a very good sample of what is now written, and too easily believed, about British manufacturers.

Mr. Garrard says that "up to the present time it has not been possible to get good electrical porcelain from any English pottery" . . . . "the art of mixing to give good electrical properties to the finished article has not yet been learned by the English potter" . . . . that "English porcelain as yet made depends for its insulating properties almost entirely upon the glaze."

In every one of these statements Mr. Garrard is wrong, and I am amazed at the ignorance of facts which he displays. Is it credible that the electricians who have put up and maintained with English insulators, the Post Office and great railway systems of telegraphs, have been so blind and incompetent as to use such a material as he describes, and could the lines have maintained their efficiency? On the

contrary, more than 30 years ago the principal specifications for telegraph insulators, provided that the unglazed porcelain should be soaked in sulphuric acid and water before being electrically tested, and then should show no loss by the galvanometer.

At the present time almost every insulator on the principal lines in England has unglazed surfaces inside and outside, and every insulator has been tested before being used. Not many months ago I had occasion to test a lot of English insulators which had been shipwrecked, and had lain in sea water for nearly six months; they were taken from the wet straw in which they had been packed, and put straight into the testing vats; not one showed any loss by the galvanometer, and yet the head of each insulator and the spindle hole were unglazed, the thickness of porcelain between these two faces being about ½ in.

Recently I have made experiments with the view of ascertaining the dielectric strength of English porcelain, and I find it difficult to get pieces made, with sufficient surface, thin enough to break down with the voltage at my command, viz., 30,000 volts; unglazed pieces, so thin as to be translucent, resisted 20,000 volts. Soon I shall have a testing apparatus which will give me 60,000 volts, and I shall be pleased to show Mr. Garrard or any representative of the Review what English porcelain will do.

I have now before me a report, from one of the most eminent British electricians, of destructive tests which he made upon English porcelain insulators. These broke down at pressures varying from 250,000 to 900,000 volts, according to their thickness and shape, but some in which the solid porcelain was about 1 in. thick successfully resisted the latter enormous pressure—a strain which can hardly occur in practice, even as the effect of resonance.

I know at least one English pottery which for many years past has turned out annually thousands of tons of porcelain of a quality more than equal to any electrical demand which can be made upon it. English porcelain is the best in the world—not only is its electrical resistance practically infinite, but it is tougher and mechanically stronger than either American or Continental porcelain, and is only glazed for the sake of cleanliness. Great American firms who have lately built works in England, to my knowledge, use English porcelain to a very large extent.

And yet we are told by one who has certainly not troubled to inquire into the matter, that up to the present it has not been possible to get good electrical porcelain from any English pottery.

John T. Harris.

Stone, Staffordshire,
August 26th, 1903.

[See our "Notes" columns.—Eds. Elec. Rev.]

Re Ramsgate Tramway Inquiry.

Would you kindly permit me to ask you whether the fashion of putting magnetic brakes upon tramcars will last much longer, after the damaging disclosures of this inquiry? The evidence clearly showed that a magnetic brake requires to be supplemented by the hand brake for stopping a car on an incline, because as soon as the car slows down the source of the magnetism is annihilated. But unless the hand brake is very carefully handled, one brake hampers the other and neither of them acts.

Some time ago much was said in these columns about pneumatic brakes, but only a few have been tried since. They are free from such defects, and have such a splendid record in other countries, that it is surprising to see them so apathetically treated here. The only objection I ever heard raised against them is higher cost of maintenance than magnetic brakes, and this objection is not only unjust, but is quite out of place where life and limb must be the first consideration.

This notion of higher maintenance costs originated years ago with some experimental air brakes of American manufacture, which were badly designed and worse made. To get them small and cheap, they were designed for 80 lbs. pressure per sq. in., and with very small bearings, valves, &c. The working parts were hardly machined, and the valves would have allowed cement grouting to trickle through under no more than atmospheric pressure. The compressor and valve castings had not even been freed from their cores, all joints leaked, and 4-oz. lumps of red lead, that was intended to make joints tight, preferred to adorn the valve faces or to block the passages of the regulator. There was nothing wonderful in this failure; but it is wonderful that tramway managers should blame the principle where only the execution was at fault, and that this bogey of high maintenance should so long survive.

It is hardly necessary to enumerate the good qualities of the pneumatic brakes, and their success on railways proves that their maintenance cannot be extravagant. Moreover, on railway cars a far more complicated type of apparatus is used, and the working conditions are far more severe—viz., higher speed, heavier jolting, and no inspection of parts possible for months.

In Germany all kinds of magnetic brakes have been tried and have failed, while the air brake is signally free from failures, and is not only fitted on about 600 cars in Berlin alone, but is going to be put on all tramcars in that economic town.

There the low maintenance expenses have been one of the chief causes of its success, and there can be no doubt that motors and controllers last longer with them than with magnetic brakes, which require 200 amperes and more where the working current of the motor averages 10 to 15 amperes.

The compressed air is there also used for sanding, and the driver's attention is not required on the sand pedal in case of emergency, as the air is automatically directed to the sanding tube whenever the controller valve is brought into the emergency position.

Skidding can be made impossible, and track and wheel brakes can be effectually combined, as has, for instance, been done on one of the cars of the Manchester Corporation.

Allow me to say just a few words with regard to expense.

Is it right that tramcar brakes should only be attended to by unskilled labour? Does it not amount to recklessness if such an important part of the equipment is left entirely to the mercy of labourers? Have tramway committees no other duty than to reduce the cost per car-mile to a minimum and to raise the receipts to a maximum? Do the coroners who absolve the drivers from blame when they kill people know that the manager employs 14 *labourers* and not a single mechanic to do all the mechanical attending to 260 cars?

Does the coroner or the Board of Trade know that air brakes are not in favour with tram managers because they would necessitate the employment of two mechanics instead of two of the above 14 labourers?

Air and Sand.

The failure of all three brakes in succession on the car which came to grief at Ramsgate would seem, according to the Board of Trade inquiry, to have occasioned much surprise. But really this was not at all extraordinary, for the three brakes in question—hand, slipper and electric—when applied simultaneously and strongly, so interfere with each others' action that failure is to be expected. The hand-brake will very readily skid the wheels, especially when part of the weight of the car is lifted off them by the slippers, and the wheels being locked, the electric brake is useless. Trolley current can never be relied upon in case of accident, as, with the car travelling fast and rocking violently, the trolley may leave the wire any moment. What is wanted is a brake that will utilise to the best effect the available sources of retardation, viz., the track, the wheels and the motors, without depending on the trolley current or the physical strengh and nerve of the motorman. It is just because it fits these conditions exactly that the Westinghouse magnetic brake has been universally adopted on all tramway systems where serious accidents have occurred. Indeed, the makers claim that it is not only the best, but the only brake suitable for modern electric tramway service. The statement was made at the inquiry that the magnetic brake fails if the hand brake is applied so as to skid the wheels. But there is absolutely no reason why the hand brake should be applied when the magnetic brake is in use, and its application is entirely contrary to the motorman's instructions. In fact, its only use is to hold the car locked in the yards or on steep inclines. The magnetic brake is not adapted for

actuation by hand, as suggested by the inspector, for the reason that the friction between a steel brake shoe and the rail would be too small to be of much use were any power other than magnetism employed. Even were this not the case, however, the makers have such good experience of the reliability of the apparatus that they would not fit a hand working attachment.

Norman D. Cameron.

Westinghouse Building, W.C.
September 2nd, 1903.

To Correct a Wrong Impression.

My attention has been drawn to certain remarks made by Mr. A. Philip, in a book on "The Electro-Plating and Electro-Refining of Metals," which seem likely to convey the wrong impression that the idea of utilising zinc dust for regenerating zinc electrolytes, originated with him.

Permit me to say that this is not the fact, and also to point out that Mr. Philip omits to mention that, at the time he refers to, he was employed by the company with which I was associated.

Sherard Cowper-Coles.

August 27th, 1903.

Hot-Wire Arc Lamps.

I have been watching your valuable "Correspondence" columns lately in order to learn all I can about hot-wire arc lamps, but except for the maker's remarks and "F. J. T.'s" letter, your correspondents appear to be very much annoyed about something, and their criticism, is, in my opinion, neither just nor justified. As for "Enclosed's" remarks, I could make any lamp jump if I wanted to, and could put most of them right if I wanted to.

It is really wonderful what you can get any lamp to do if you want. I could have stopped the jumping in a few minutes, for I have had a Foster lamp under my observation for some time, and I find it simple and easy to understand. It has never jumped since its delivery, six weeks ago, possibly because I have not interfered with it, and have no desire to see it jump. There appear to be no "complicated levers" in the lamp, and I think that "Enclosed" must have some other make under observation. I saw no complications in the sketch given in the columns of your valued journal of July 31st, and, as far as I am concerned, am delighted with the light given, and the simplicity and working of the lamp.

W. J. Woodward.

The Vulcan Electric Co.,
43, Broadway, Stratford.

I have read Prof. Mundella's letter in the current Review, and greatly regret that I omitted to ask his permission before stating the facts of his inquiries for a change-over lamp. I beg herewith to humbly apologise to Prof. Mundella; the facts, however, have been, I believe, common knowledge in arc lamp circles for about a year.

J. G.

August 29th, 1903.

I do not wish to contribute to the discussion on hot-wire arc lamps, but it shows how much "N. D. W." knows about his subject when he refers to "Manchester —— Councillors interested in the gas company!"

A. J. C.

I notice that Messrs. Foster & Co. do not contradict my statements.

With an enclosed arc of 70 volts or less the carbons are fairly close together, and the lower carbon obstructs a considerable quantity of the light emitted by the upper; but with 80 or 90 volts across the arc there is much less obstruction owing to the greater distance between the carbons, and consequently more *useful* light is obtained in spite of the theoretical reasons to the contrary (see text-books). Mrs. Ayrton's book goes into this rather fully, and a simple experiment will prove it. I am speaking above of 13 mm. carbons as used in the Foster and most other makes of lamps. With 10 mm. carbons the obstruction of light is not quite so great, but of course the burning hours are much reduced owing to the smaller carbon.

On alternating current circuits the resistance should be kept as low as possible for economy's sake, hence a hot wire is a disadvantage; as with a lamp taking 5 amperes and with a resistance in the strip of 2 ohms there is a dead loss of 50 watts. This is in addition to the slight loss in the choking coil, which in a good design can be kept below 10 or 12 watts easily.

Regarding change-over lamp, most alternating current lamps, if supplied with a resistance instead of a choking coil, will burn quite satisfactorily on a continuous circuit.

I would remind "Fair Play" that four months is not very long in which to try a new lamp.

Enclosed.

Excepting "F. J. T.'s" letter in your last issue, we are inclined to think that "Fair Play's" letter in this touches the real crux of the criticism we have been lately receiving, and beg to call the attention of your readers to this point.

As regards our remarks in your issue of 14th inst. on "N. D. W.'s" letter, we were then, and are now, of the opinion that his letter contained many errors, and was an unwarranted attack upon an able and moderate article written by an engineer of experience and position, and one not at all likely to write on a subject he was not quite sure of. We therefore considered "N. D. W." deserved rebuke, and that his misquotations and mistakes should be made clear in the eyes of your readers. Apart from this, we do not desire to abuse him—only to rebuke his temerity.

Referring to "N. D. W.'s" letter in the current issue, we may say that whatever the *striking* current is, or the flush between switch-on and *striking*, the strip does carry it, as is evidenced by "Fairplay's" letter, and in the name of common sense, if it did not, should we go on making the lamp in such quantities as we are? And would people buy them as they do?

In dealing with the faults of his lamp, "N. D. W." says, "the percentage of failures due to dash-pot sticking . . . . is ·1 per cent., while dirty rods, &c., account for ·9 per cent. *of the known cases of failure.*" These are his own words, and leave unaccounted for, 99 *per cent. of the known cases of failure.*

As regards the large amount of combustible insulation used in solenoid lamps, we refer, of course, to the double layers of cotton covering on the wire of the solenoid, which we avoid.

Dealing with the question of efficiences on A.C. circuits, our experience is, when in competition with other makes, that we give the same or a better light, as the case may be, but always with a saving of power, as measured by a watt-meter. Does it matter how we get it so long as we do? We might add, however, that the internal resistance varies with circuit conditions, being about half an ohm on alternating circuits.

Our "limited field" of action has kept us working overtime since the beginning of this year. As to the demand for constant current working with the enclosed lamp, there are only a few instances in England—Croydon and Exeter being the only ones we can think of. We are, however, quite prepared for it.

We should like to add, in conclusion, that we have no personal dislike to "N. D. W.," and that we think there is room for us both, without cutting each other's throats.

Foster & Co.

September 1st, 1903.

[We do not think that any useful purpose will be served by a further continuation of this correspondence.—Eds. Elec. Rev.]

Speed and the Public Safety.

It is a pity that the writer of your leaderette under the above heading should not have had some knowledge of the matter he writes about.

The matter is of some importance to Londoners, and such mistaken inferences as he draws from Dr. Louis Bell's interesting paper, which is chiefly on electric tramcar speed and brake power, do harm. Surely it is worth the while of technical journals to differentiate themselves in some degree from the dailies when they write on matters such

as this question of speed in traffic, which involves a good deal of interesting engineering problems. It is evident from the sneer at "A. A. C. S." that they doubt or disbelieve his speed measurements. If the writer had taken some trouble in the matter instead of dashing off his leaderette *ex cathedrâ*, with no expert knowledge to guide him, he would have known that having made a number of tests of speed of various vehicles running in London, at the request of high authorities, I can confirm all that "A. A. C. S." stated in his letter to the *Times*, and that these speeds are correct, and that Mr. Woodfine's assertion that if motor-cars are restricted in London or any large city to a maximum speed of 10 miles an hour, you will deprive them of their most useful qualities.

Your leader writer makes the very common mistake of confusing average with maximum speeds, and thereby confuses instead of helping your readers to understand this matter.

The distance from this house, measured through the streets, to Ludgate Hill is $3\frac{3}{4}$ miles. I cannot do it by omnibus or cab under $\frac{3}{4}$-hour. The average speed of that vehicle is therefore only about 5 miles an hour—in spite of the driver occasionally, whenever he gets a few yards clear, attaining 12 miles, or possibly 14, as a maximum.

If I come, as I may at present, on a bicycle or a motor-car, I can accelerate and again control my vehicle so rapidly so as to take advantage of the intervals in the traffic, that I can come to you in 20 minutes. Now raise my average rate from 5 miles an hour up to 10 miles, and this is what I stated at the Engineering Conference; your writer makes me appear to say something very different.

R. E. Crompton.

"Thriplands," Kensington Court.

[There is no need to reply at any length to Lieut.-Col. Crompton's letter. Half Dr. Bell's paper is devoted to the 40 miles an hour "Red Devil," and this is the portion to which our remarks applied. Our reference to "A. A. C. S.," too, was in connection with the correspondence between himself and Sir Albert Muntz, and there is not the slightest ground for saying we doubted or disbelieved his speed measurements. Finally, we quoted our correspondent quite correctly; we said, "from its present *average* of 5 miles to 10 miles per hour."—Eds. Elec. Rev.]

In your issue of the 28th inst., there appeared an article referring to the contribution of Dr. Louis Bell and also to the letter sent by this Society to the Public Control Committee, London County Council. As the article in question comments adversely upon the Society's case, and in so doing makes statements which show that the writer is not at all acquainted with the question, I trust you will allow me to point out some of the errors he makes.

In the first place, he speaks of vested interests. There are, of course, none in connection with automobiles such as exist in the case of railways and tramways. With reference to the comparative safety of motor-cars compared with trams, Mr. Balfour's statement could not be better substantiated than by Dr. Bell himself, when he says that at 12 to 18 miles per hour the space required for stopping varied from 101 to 205 ft. This is at least five or six times as great as that required by a motor-car, and the element of danger is in proportion. The fact that the tram is confined to fixed rails makes it more, and not less, dangerous in this country, because generally the roads are so narrow that there is not room enough to treat the tracks as railroads and keep off them.

The writer in question quotes Lieut.-Col. Crompton's statement that the present average speed of traffic in the metropolis is only 5 miles per hour, but may in the future be increased to 10, and triumphantly inquires how, therefore, can a limit of 10 miles per hour adversely affect motor vehicles. He must be very ignorant of the road if he does not understand that, if one drives considerately, it is difficult to average one-half the maximum speed. This holds good for very long distances, but still more so in London, where, in order to average 5 miles per hour, it would be necessary, sometimes, to exceed 10 miles per hour. Plainly, therefore, in order to bring the average up to 10 miles per hour, the maximum must be considerably greater.

The observations made in Victoria Street, Westminster, S.W., by Mr. Swinton (there never was any concealment as to his name), carry no weight with this society, save as certifying to a fact well known to everybody who is any judge of speed. Why any reference should be made to Sir Albert Muntz, who is the person, perhaps, above all others interested in horse breeding in this country, it is difficult to understand.

When the writer speaks of motors being driven frequently at 50 miles an hour at cross roads or going round a corner, he shows a complete ignorance of speed, as it is very rare indeed that this pace is ever attained on English roads. Probably if he saw a car going at 30 miles an hour he would estimate it at 50.

In conclusion, I quite agree with the article by Dr. Bell, which is a very strong case for the motor. He admits that 15 miles per hour may be permissible for tramcars, which he himself points out, require five or six times as much stopping space as a motor.

Where could one find a stronger case for allowing motors to exceed this speed, specially since they can, as he goes on to remark, readily turn out for other vehicles.

J. F. Woodfine,

Secretary Society of Motor Manufacturers and Traders.

August 31st, 1903.

[By vested interests, the writer intended it to be understood that Mr. Woodfine was naturally speaking from the point of view of money invested in the automobile industry.

We have only this to add to what we have already said concerning the comparative safety of motor-cars compared with trams. The man in the street knows exactly what to look out for with trams, simply because they do not *readily turn out;* with motor-cars he is never certain of what may happen. Moreover, we presume that narrow roads are not in the habit of expanding to oblige the motor-car.

With regard to Lieut.-Colonel Crompton's paper, we said nothing about maximum speeds; the figures we gave were for *averages* only.

Is there any reason why a gentleman interested in horse-breeding, who sees the abuse as well as the use of motor-cars, should not advance sensible views on the abuse of them?

Misquoting Dr. Bell will not help matters. This is what he said:—

> The automobile as a practical working vehicle for ordinary purposes will involve no serious speed questions. A speed limit of 15 miles an hour, enforced, as just noted, would probably be actually a good thing for the progress of the art, tending to the development of useful vehicles capable of running long distances under load, and eliminating most of the objectionable characters who would abandon the sport if kept to moderate speed.

Mr. Woodfine does not advance the cause he advocates by such a letter as the above; and, again, we say that unless he can make use of better special pleading than this, his case with the L.C.C. seems a hopeless one.—Eds. Elec. Rev.]

[A correspondent wants to know the name of the manufacturers of Sinclair's patent resin solder.—Eds. Elec. Rev.]

BUSINESS NOTES.

German Electrical Manufacturing Imports and Exports.—The German Customs Returns for the six months ending with June last show that so far this year there has been a marked falling off in the imports of foreign electrical machinery into the country, the amount during the period named being given as only 369 tons, as compared with 764 tons in the first half of last year. On the other hand, there has been an increase in the exports of electrical machinery from Germany from 5,977 tons in the first six months of 1902 to 6,283 tons in the six months ending with June last.

Forthcoming Book.—Messrs. Longmans, Green & Co. beg to announce they will publish during September a new edition of "The Steam Turbine," by Robert M. Neilson. The size of the volume has been nearly doubled. Large additions have been made to the chapters descriptive of the Parsons and De Laval turbines, the additions including dimensions drawings.

Telegraph Cable Imports.—The value of the foreign telegraph cables and apparatus imported into this country last month amounted to £3,591, bringing up the total for the first seven months of the current year to £33,731.

Electrical Wares Exported.

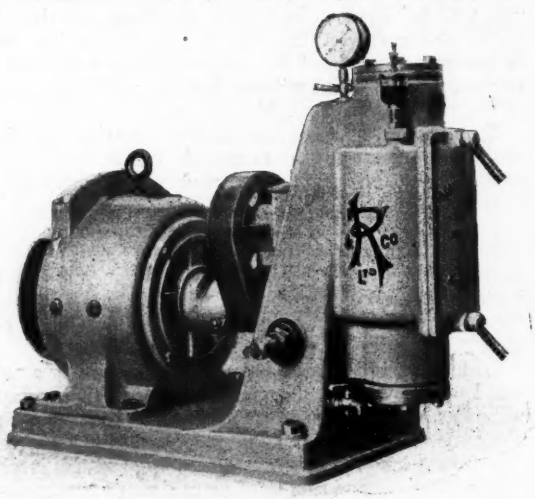
Week ending Sept. 2nd, 1902.		Week ending Sept. 1st, 1903.	
Alexandria. Teleph.appar.	Value £113	Aden	Value £24
Amsterdam	33	Amsterdam	50
Antwerp	333	Auckland	134
Bombay. Teleg. wire	220	Beira	19
Buenos Ayres	46	„ Teleg. mat.	181
„ Teleph. mat.	389	Brisbane	106
Calcutta	30	Buenos Ayres	20
Demerara	40	Calcutta	339
Durban	64	Cape Town	134
„ Teleg. mat.	1,152	Channel Islands	36
East London	50	Christchurch	38
Gibraltar. Teleg. instru.	132	Colombo	312
Hong Kong	16	Copenhagen. Teleg. mat.	53
Jersey and Guernsey	50	Delagoa Bay	48
Madras	16	Durban	626
Melbourne	66	„ Teleg. mat.	452
„ Teleg. wire	193	East London	379
Nagasaki	212	Flushing	56
New York	130	Gibraltar	45
Singapore	54	Libau	70
Stockholm. Teleph. cable	302	Melbourne	70
Sydney	57	Montreal	21
		Perth	18
		Port Elizabeth	76
		Progresso. Telephones	285
		Rangoon	12
		Rio Janeiro	247
		St. Petersburg	24
		Saigon	40
		Santos	383
		Singapore	49
		„ Teleg. mat.	43
		Stockholm. Teleg. wire	52
		Sydney	670
		Toronto	85
		Wellington	1,045
		Yokohama	645
		„	20
Total	£3,698	Total	£6,907

Foreign Goods Transhipped.

Bombay. Elec. mat.	Value £75
East London. Elec. apparatus	255
Santos. Elec. mat.	86
Sydney. Elec. mat.	85
Total	£502

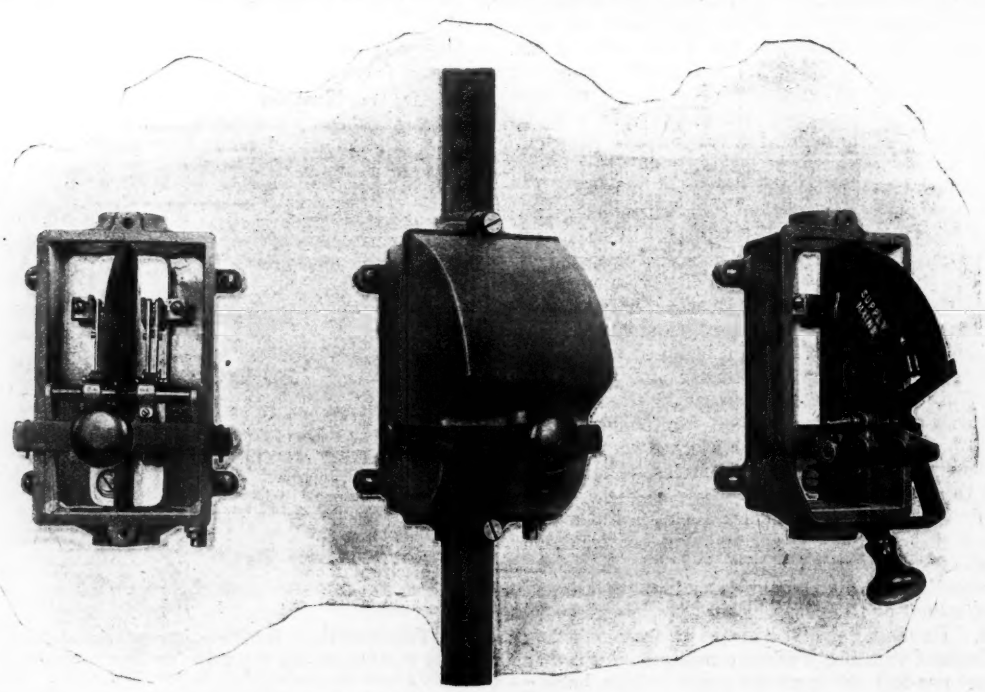
New Switches.—The Holmes-Page patent switches have been designed to meet the requirements of the various fire offices, electricity supply companies and municipal authorities, and they are arranged so as to embody all the features of the Holmes-Page chopper switches. The box is of cast-iron, and is made practically watertight; screwed holes are provided at the ends to receive insulated bushes or iron pipes carrying cables. The switch is operated by means of a stirrup handle, which fits outside the box when the cover is on, and it is so arranged that the box cover cannot be removed without first opening the circuit. The entire switch parts, excepting the two top contact jaws, are dead when the switch is open. The inside surface of the box is thoroughly coated over with a specially-prepared insulating japan, which will not crack or blister when subjected to severe heat or rough usage. The box is provided with suitable means for earthing. The special feature is that the supply main may be brought in at either end and still be connected to the top contact jaws.

Compressed Air Cleaning for Electric Lighting and Power Stations.—Messrs. Reavell & Co., of Ipswich, who have been manufacturing for some time a compact little motor-driven compressor for the above purpose, have recently still further improved upon the design by totally enclosing the suction, as shown on the accompanying illustration. The advantages of the enclosed suction not only enables cold air to be brought into the



Reavell Motor-Driven Compressor.

suction chamber of the compressor, which naturally improves its efficiency, but it enables the compressor to be installed in a suitable position, regardless of whether that position is hot, or whether the atmosphere is charged with dust. The enclosed suction arrangement has the further advantage that the whole of the working parts are thus enclosed. The standard machine supplied has a capacity of 18 c.f. of free air per minute, and the compressor runs at 400 revolutions per minute. The motor is of 2 h.p., and runs at about 1,200 revolutions per minute, being geared to the compressor by a raw hide pinion on the motor, and a cast-iron spur wheel on the compressor shaft; the latter wheel is machined from the solid, giving a drive which runs very smoothly. The gears are covered by a neat planished steel gear case. Although the above machine illustrates the usual type, it is sometimes made portable, and pro-



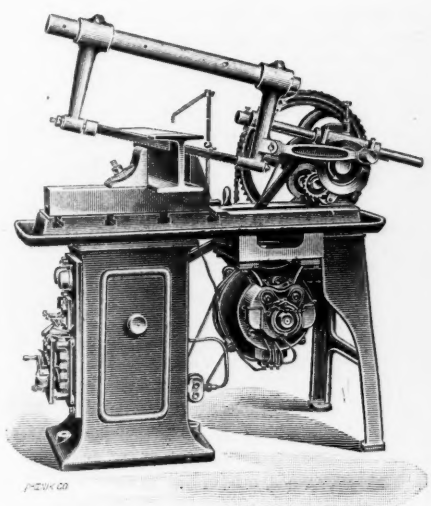
The Holmes-Page Patent Switch.

points claimed are:—Neatness in appearance; the switches are carried on porcelain bases, and are separated by a substantial partition, thereby securing a very high insulation resistance; the switch has self-adjusting contacts, and is easy to wire. An important

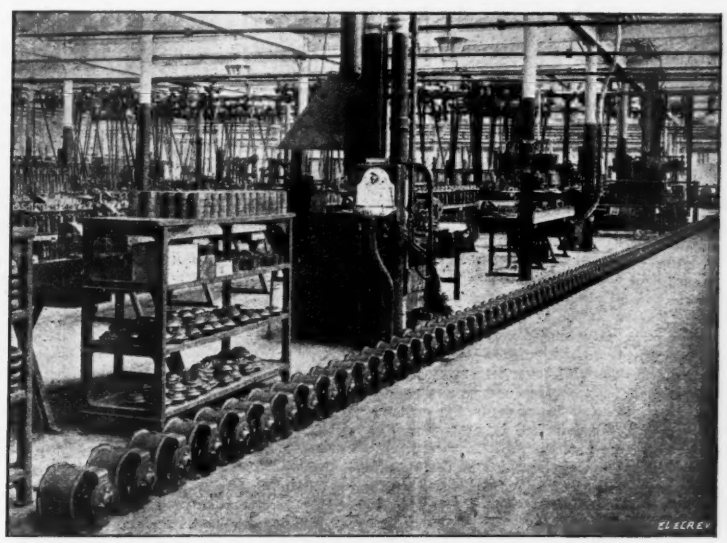
vided with rubber shod wheels, so as to enable the machine to be drawn over a tiled engine room floor. Messrs. Reavell & Co. report that the use of these little machines in sub-stations is increasing; they form a useful accessory for such stations as well as

for power stations themselves. We understand that the makers have supplied compressors of this type to the Manchester, Halifax and Salford Corporation electricity works; Charing Cross and Strand Co. (6 sets); Glasgow Corporation Tramways (5 sets); Barking Town Council; Hull Lighting and Tramways; Edinburgh electric lighting station; Central Supply Co., London; Newcastle-on-Tyne Corporation Tramways; Midland Railway Co., Derby; Lincoln electricity works; St. James's and Pall Mall Electric Light Co.; London County Council Tramways; Poplar, Islington and Shoreditch Corporations; Stalybridge tramway power station; Croydon electricity works; Metropolitan Electricity Supply Co.; Calcutta electricity station; Sunderland Corporation Electricity Department (4 sets).

A Motor-Driven Hack Saw.—We illustrate herewith a quick-cutting eccentric sawing machine made by Messrs. Edward G. Herbert, Ltd., of Cornbrook Park Works, Manchester. The machine has an eccentric on the main shaft on which the guides of the saw frame are mounted, the eccentric being so geared as to make a part of a revolution after every 20 strokes of the saw. The inclination of the saw is thus changed periodically, and the cutting speed is greatly increased as compared with the ordinary hack saw. The cutting speed is further increased by running the machine at double the ordinary speed, and using a rotary pump to supply the blade with water. The machine illustrated below is the No. 2 size, capable of cutting bars and girders up to 12 × 8 in., and the motor, which is fixed in an inverted position under the bed, is of the fully enclosed constant speed type, specially wound for a speed of 600 revolutions, and gives ½ H.P. at that speed. The power required is very small. The machine is driven direct from the motor by chain gearing, having a ratio of 6 to 1, making the speed of the machine 100 revolutions per minute. As all the necessary switches are attached to it, the machine is entirely self-contained and portable. An eyebolt is provided for lifting it by the crane. Power can be taken from the lighting cables by means of a flexible conductor and lampholder plug. This machine is suitable for engineering works where electric driving is in force, and also for iron merchants and others who have no shafting; structural engineers, also, will find it a useful tool to have working on the job.



Motor-Driven Hack Saw.



Crompton & Co.'s Small Motors.

Dissolutions and Liquidations.—Messrs. L. I. Robinson and R. G. W. Ellis (Lionel Robinson & Co., electrical engineers and instrument makers, 9, Carteret Street, Westminster) have dissolved partnership.

Messrs. L. Barlow and J. Young (Barlow & Young, electrical and general engineers, 8, London Street, E.C.) have dissolved partnership. Mr. Barlow attends to debts and continues the business under the old title.

Messrs. A. Slatter and R. G. Goatcher (Alfred Slatter & Goatcher, art metal workers and electrical engineers, Buckingham Street, Strand, and Peckham) have dissolved partnership.

The members of G. F. Milnes & Co., Ltd., resolved on August 18th to wind up voluntarily, and Mr. Max Meyer, of Hadley, near Wellington, was appointed liquidator. Creditors must send particulars to him by October 15th.

Messrs. O. Rennert, P. Hensel and F. J. Zelzer (P. Hensel and Co., electrical specialities manufacturers, 12, Long Lane, E.C.) have dissolved partnership. Messrs. Rennert & Hensel will continue the business under the old style, and will attend to debts.

For Sale.—The Glasgow Corporation invites offers for the purchase of copper strip, wire, lead and scrap iron, at the electricity department stores. See advertisement pages.

Electric Trams Trust, Ltd.—Before Mr. Justice Walton, sitting as vacation judge in the High Court of Justice, on Wednesday, a petition was presented by Mr. W. Bratby for the compulsory winding up of the Electric Tramways Trust, Ltd.—Counsel for the petitioner said he had only received the affidavit of the respondents on the previous day, and he asked for an adjournment for a week in order to answer it.—Mr. Bramwell Davis, K.C., said the company was in voluntary liquidation, and he appeared for the liquidator, and did not object.—The hearing of the petition was adjourned accordingly.

Boiler-Covering Composition.—In reference to our recent note on the new destructor works erected by Messrs. Manlove, Alliott & Co., Ltd., for the Nottingham Corporation, Messrs. F. Leroy & Co., of Manchester, covered the boilers, steam pipes, &c., with their patent non-conducting composition.

Small Motors.—Some little time ago Messrs. Crompton and Co., Ltd., of Chelmsford, decided to give greater attention to the supply of small motors for domestic and industrial purposes. They had previously manufactured such motors in small quantities, but in view of the increasing demand resulting from the great accession of small power users throughout the country, and believing that the business would be even greater but for the high market price, the firm thought that by availing themselves to the full of the modern machinery with which the Arc Works are equipped, they could turn out a cheaper motor in large quantities without in any way interfering with the quality of workmanship and materials employed in the construction. In the accompanying picture we give a view of one of the departments, from which a rough idea may be gained of the quantities in which they are turning these motors out at present. It is claimed that by manufacturing in such large quantities the requirement as to price has been met, and the motors are built and tested with precisely the same care as are the larger machines. The company has issued two small pocket price cards of continuous-current enclosed ventilated motors from ¼ up to 40 H.P. for 100—110 and 200—220 volts.

Catalogues and Lists.—Messrs. H. V. Kramer & Co., of Locksbrook, Bath, have sent us one of their new catalogues of electrical machinery and apparatus. It consists of numerous sheets which have been caught together in the usual convenient way, allowing additions to be easily made. There is no constructional or general information given respecting the different lines of machinery, the lists being in the main a collection of illustrations of standard motors and generators, motor combinations, a new type of electric furnace for rivets suitable for shipbuilding and engineering yards, and portable electric motor braces, such as are already being used by a number of such yards in the country. The firm's patent ball bearings having been so successful with smaller motors and generators, are now supplied with the larger machines, and among the pictures is an 80-H.P. D.C. ball-bearing motor; another of the illustrations shows the driving of embroidery machines by small separate three-phase motors also with ball bearings. Messrs. Kramer claim that separate driving is more economical than group driving, if such devices are adopted.

Messrs. Bray, Markham & Reiss, Ltd., of Walthamstow, have brought out a set of price sheets giving a full description of their switchgear manufactures. No. 1 is devoted to their double-pole switches; No. 2 and 3 particularise their ratchet type starters; and No. 4 is entitled "A few points about the 'B.M.R.' manufactures."

Messrs. D. H. Bonnella & Son, Ltd., of Mortimer Street, W., have placed before us a copy of their new list, dealing with electric bells, accessories, electro-medical apparatus, small electric novelties, speaking tube fittings, and so forth. Nearly every article which is included in the 50 pages of this list is pictorially shown.

MESSRS. ALLEY & MACLELLAN, LTD., of Sentinel Works, Glasgow, have sent us a copy of their new high speed engine catalogue, No. 17 E; it describes their latest pattern of double-acting forced lubrication engine for dynamo driving, &c., a considerable number of which are now in hand for Corporation and other orders. A splendid collection of half-tone process blocks are distributed over the 46 pp., being made from photographs of 400-H.P. engines which they have supplied for the Gravesend electric lighting station; similar size engines for Mansfield station; a 750-H.P. tandem compound engine which was supplied to drive a 440-KW. single-phase alternator at the Burton-on-Trent electricity works; a 250-H.P. tandem compound engine driving an alternator at Prescot electric light station; also other "Sentinel" engines at Rhyl. The book also contains pictures and a description of forced draught apparatus, condensing plants, air compressors, pumps, hoisting machines, &c. The closing pages contain useful tabulated particulars of engineering interest, such as H.P. data respecting cotton and leather belt driving at various speeds, properties of circles, and metric equivalents.

Mr. A. H. S. DYER, electrical engineer, of Stansted, Essex, is making a speciality of building commutators for the trade, and he has issued a small list giving a brief specification. He states that he has some 3,000 different types of commutator bars to offer, and sets out some of the reasons why the trade should purchase commutators ready to connect to armature windings.

MESSRS. W. F. DIXON & Co., of C.-on-M., Manchester, have issued a new circular respecting their Buffalo raw-hide silent gears. Instances are quoted of their pinions which have been running 140 hours per week at 800 and 900 revolutions, developing 40 B.H.P. and upwards, for more than four years, are still running well, and promise to remain in good condition for several years yet.

An "August" list just issued by the LANCASHIRE DYNAMO AND MOTOR CO., of Trafford Park, fully details and illustrates the construction of their two and four-pole machines; outputs, speeds, prices, code words and so forth, being set out in table form. Full dimensional and shipping data is given.

We have received from the ARMORDUCT IMPROVED ELECTRIC CONDUIT CO., of Newcastle, a copy of their newly-issued catalogue (illustrated and priced) relating to the Armorduct system; "Armorduct" is claimed to be a high-grade welded steel tube which, by its bending qualities and the use of screwed couplings, ensures a permanent non-corrodible and waterproof duct for the electrical conductors. The company's manufacturing process enables them to obtain a gun-barrel smoothness in its interior, whilst the moisture and acid-proof enamel with which it is treated has such tenacity that it does not chip or flake off during installation. The fittings, such as boxes, bends, elbows and tees, &c., have been designed with a view to reducing and simplifying labour and effecting a saving in first cost and time of erection.

The LIVERPOOL ELECTRIC CABLE CO., LTD., has a revised price list of electric light wires and cables ready for issue.

A catalogue (No. 15) of tools for cutting screw threads has been received from the J. M. CARPENTER TAP AND DIE CO., of Pawtucket, U.S.A.

MESSRS. JAMES C. KAY & Co., of Phœnix Foundry, Bury, Lancs., are now placing upon the Indian and Eastern market, Hull's patent oilless Punkah wheels, of which circulars have been issued.

The BRITISH THOMSON-HOUSTON CO., LTD., has issued pamphlet No. 150, dealing with its patent horizontal cylinder air compressors for electric train equipment. It is well illustrated, as usual.

We have received from MR. JAMES MURCHIE, of Glasgow, a price list of square head cap pointed set screws. He has taken over the engineering department of the business of Dexter & Co., of High Wycombe, who have manufactured these screws for the past 20 years.

MESSRS. GABRIEL & ANGENAULT, of 15, Victoria Street, S.W., have issued a pamphlet relating to their insulating materials roburine and mineralite. A number of pictures show the works where the roburine is mixed, crushed, moulded, &c. A summary of experiments made as to insulating capacity is given, and a number of pages show parts of batteries, overhead trolley material, arc lamps, &c.

Circular No. 60 just published by MESSRS. VERITYS, LTD., is devoted to their stock lines of switches, cut-outs, wall shoes, lampholders, ceiling roses, distribution boards, and ornamental electrical accessories. In all cases clear illustrations and dimensional particulars, with prices, appear. The latest type of "Peard" patent motor and house-service fuse is described.

We have received from the ACCUMULATOR AND MOTOR CONSTRUCTION CO., LTD, of 11, Queen Victoria Street, London, E.C., an illustrated price list of their "A.M.C." stationary cells for all rates of discharge up to 1,300 amperes for three hours, and booster batteries discharging up to 2,430 amperes for one hour. The plates are made on the Boese system, with formed positives and pasted negatives. A sample of the former has been sent to us, which shows the ingenious manner in which the maximum active surface is obtained, while retaining mechanical strength and freedom of circulation of the electrolyte through the plates. A number of reports made by various Continental authorities on these cells accompanied the price list. The reports are exceedingly favourable, and generally show an ampere-hour efficiency, under normal conditions, from 93 to 97 per cent., and a watt-hour efficiency of 77 to over 80 per cent.

Bankruptcy Proceedings.—The public examination of Noel Francis Nalder, electrical engineer, was held last week at the London Bankruptcy Court before Mr. Registrar Linklater, the accounts showing total liabilities £10,218 5s. 10d., of which £8,782 15s. 10d. are expected to rank, and assets of no realisable value. In reply to Mr. H. E. Burgess, Assessor and Official Receiver, the debtor stated that he commenced business as an electrical engineer in 1893 in partnership with a Mr. Harrison, at Trafalgar House, Great Newport Street, St. Martin's Lane, W.C., with a capital of £2,500, provided by witness. After trading for 18 months the business had increased considerably, and more capital being required, it was converted into the Nalder and Harrison Construction Syndicate, Ltd., with a nominal capital of £15,000. Witness acted as managing director of the company until it was wound up in April, 1896, because the business was not profitable, and the expenses were in excess of the profits. After the winding up witness and a Mr. Hilton acquired the electrical part of the syndicate's business, and in 1897 they formed Nalder and Hilton, Ltd., with a nominal capital of £20,000, to take it over. He (debtor) acted as managing director, at a salary of £150 a year, of that company, but it also came to grief in 1899, the expenses proving too much for the profits. He had also been connected with other companies outside the electrical trade, and he attributed his insolvency largely to loss and liabilities incurred in connection with those promotions, but primarily to losses in establishing and carrying on the electrical manufacturing businesses. His personal expenses had been at the rate of about £600 or £700 a year. Mr. F. C. Willis appeared for the debtor, whose examination was ordered to be concluded.

Holidays in Germany.—"Holidays in North Germany and the Harz Mountains," is the title of the latest pamphlet issued from 30, Fleet Street, E.C., in Mr. Percy Lindley's series. It describes the attractions of Berlin and the interesting old towns of Brunswick, Hanover, Hildesheim, &c., and the picturesque and little-known Harz Mountains District, also the greatly increased facilities that now exist for getting there.

Trade Announcements.—The business of Stern Bros. has, as from June 17th last, been converted into a company, the Stern-Sonneborn Oil Co., in which Messrs. I. Stern, L. Stern and I. Sonneborn are directors, and will continue their same active interest in the business. No change has been made in the *personnel* of the firm or its officers, and Messrs. Wallach Bros., of 57, Gracechurch Street, E.C., will continue to act as the general managers for Great Britain and Colonies.

The B.T.H. Co. has recently organised a new department termed the "Local Companies Department" to handle its extensive business in connection with traction, lighting and power schemes in various parts of the country, and has appointed as manager of this department, Mr. A. W. Jones, who has been on the B.T.H. Co.'s staff since its formation, and for the past three years has acted as assistant manager.

The business of Sybry, Searls & Co., manufacturers of tool and other steels, of Cannon Street Works, Sheffield, has been converted into a limited liability company. Mr. V. F. J. Tlach has been appointed managing director, and Mr. E. C. Ibbotson, F.C.S., will undertake the management of the works.

Messrs. Smithson Sharpe & Co., of Chase Street, Red Bank, Manchester, have built new centrally situated premises which are fitted with every convenience for rapid and economical handling of goods. They have removed as from September 1st to their new works in Sykes Street, Chester Road, Hulme, Manchester. They make a speciality of quick repairs to all kinds of arc lamps. They have lately supplied 70 odd of their patent arc lamp elevators for the Stuart Street generating station at Manchester.

Messrs. Robert Bowran & Co., of 3, St. Nicholas' Buildings, Newcastle-on-Tyne, have been appointed sole agents for the Northern Counties for the Hart Accumulator Co., Ltd., of Stratford, London, E.

Books Received.—"Treatise on Thermo-dynamics," by Dr. Max Planck, translated by Alexander Ogg. London: Longmans, Green & Co. 1903. 7s. 6d. net.

"The Art of Illumination," by Louis Bell, Ph.D. London: Arch. Constable & Co., Ltd.

Institution of Electrical Engineers, List of Officers and Members, corrected to June 30th, 1903.

"Practical Construction of Electric Tramways," by W. R. Bowker. London: E. & F. N. Spon, 125, Strand. Price 6s. net.

For Sale.—The plant and stock of the Electric Motive Power Co., Ltd., Caistor Road, Balham, is to be put up for sale by auction on the 18th inst.

American Electrical Exports.—The value of the exports of electrical appliances, including telegraph and telephone instruments, from the United States during the 12 months ending with June last amounted to £841,323, as compared with only £726,351 in the preceding year. Of electrical machinery the exports during the fiscal year 1902—1903 were valued at £1,155,891, as contrasted with £1,075,949 in 1901—1902. The United Kingdom is by far the largest customer for American electrical machinery, having taken £451,212 of the total, but it is noteworthy that the shipments to this country are declining. Canada comes second on the list, followed by Mexico and Japan.

The Tariff Question.—On September 16th, Messrs. P. S. King & Son will publish a book on the Tariff Question, by Prof. W. J. Ashley, Dean of the Faculty of Commerce at the University of Birmingham, of which university Mr. Chamberlain is Chancellor. The author is in general sympathy with the Colonial Secretary's proposals, but goes deeply into the economic considerations involved, and his work, while aiming at being quite scientific in spirit, will be addressed in style to the general educated public. The book will be issued at a popular price, and will, no doubt, be widely read.

ELECTRIC LIGHTING AND TRACTION AT SOUTHEND-ON-SEA.

We once heard a municipal dignitary, in making a speech at an inaugural banquet, assure his hearers that "they never did anything in a hurry," a statement which, we imagine, will not tax the credulity of our readers; to a great extent this remark applied until recently to the developments in municipal electrical work at Southend-on-Sea.

The great popularity of all the watering places round the mouth of the Thames, and of Southend in particular, with its enormous crowds of holiday-makers, renders the provision of electric light and tramways almost obligatory, and a short account of these developments in the latter place will probably be of interest to our readers.

After passing through the vicissitudes of an undecided mind for several years, the Corporation finally applied for a Light Railway Order in November, 1898, which was granted, and subsequently in May, 1902, a further Order was similarly approved for an extension. The system of light railways, some 6¼ miles in length, was opened in July, 1901, and connects Leigh, Westcliffe and Southend; extensions will shortly be taken in hand towards Shoeburyness.

The contract for the whole equipment, including the generating plant, was placed with Messrs. Dutilh-Smith, M'Millan & Co.; the generating plant has since been added to and utilised for the lighting system, which was organised and laid down by Mr. Heenan on his appointment to the position of borough electrical and tramways engineer in December, 1901.

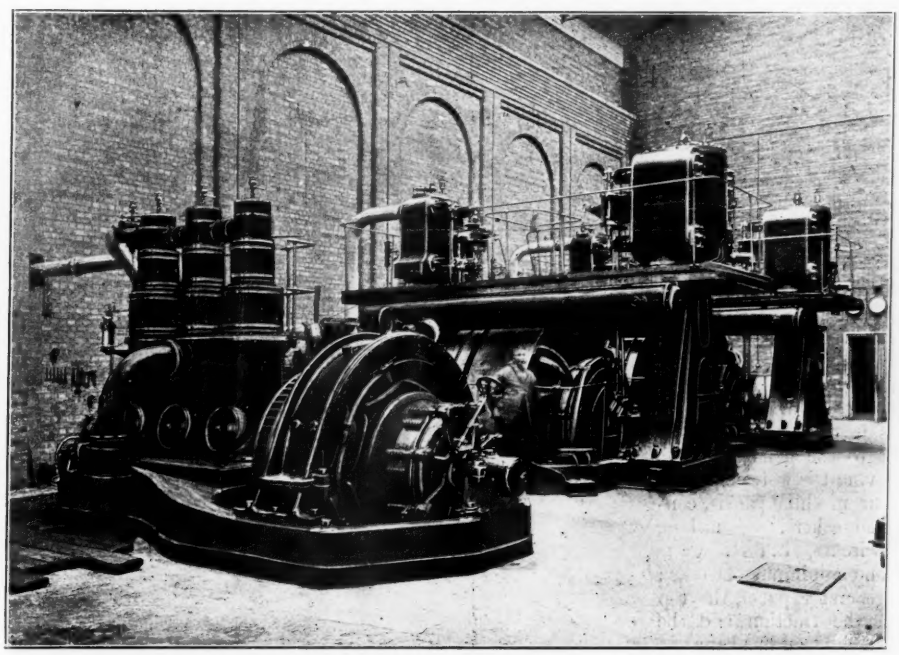
The rapid progress which the lighting department has, made since that date has fully loaded the existing plant and the Corporation have applied to the Local Government Board for their sanction to the borrowing of a further £20,000 for the purpose of extensions.

The generating station and car-shed are situated on a piece of land lying off the London Road, which is also utilised as a Corporation depôt.

The station buildings contain engine and boiler houses, battery room, workshop, test rooms, and offices.

The engine room measures 85 ft. 6 in. × 45 ft. 6 in., and, contrary to the general rule, it has an exceedingly plain interior. In it are installed four engines and generators, of which the two larger are of the vertical compound Corliss type, with the generator situated between the high and low-pressure cylinders. Both engines and generators were originally built by Messrs. Bow, McLachlan, of Paisley, but did not come up to the specification, so that eventually portions of the engines were rebuilt by Messrs. John Musgrave & Sons, Bolton.

The generators are eight-pole compound-wound machines, running at 110 revolutions per minute; they have slot-wound armatures, mounted on a spider on the crankshaft.



View of Engine [Room]; Southend Electricity Works.

The normal output is 200 kw., but the machines were specified to give a 50 per cent. overload for two hours, or a momentary overload of 100 per cent.

The other generating sets are Willans three-cylinder compound engines, one coupled direct to a Bruce Peebles 125-kw. multipolar compound-wound dynamo, running at 360 revolutions per minute, and the other coupled direct to a Crompton multipolar compound-wound generator, giving 225 kw. at full load. It is intended to put down a further set of 350-kw. capacity in connection with the extensions.

In front of the switchboard are positive and negative battery-charging boosters, by Messrs. Crompton & Co., each capable of giving 90 amperes at 100 volts when running at a speed of 1,000 revs. per min., and a balancer, also by the same firm, constructed to deal with an out-of-balance load of 150 amperes. These machines are bipolar, and run at 950 revs. per min.

At the end of the switchboard there is a 72-kw. motor-generator, by Messrs. Crompton & Co., consisting of two

multipolar machines, for voltages of 460 and 500 respectively.

This machine is utilised for running the tramways off the battery in the early morning and at periods of light load, and conversely for feeding the lighting side from the traction bus-bars.

The switchboard, which is situated on a gallery about 6 ft. above the engine-room floor level, and on the opposite side to the boiler house, is constructed of grey marble, the traction panels being on the right, the lighting panels on the left, and the battery panels in the centre.

View of Victoria Avenue and London Road Tramway Crossing.

There are four traction feeder panels, equipped with circuit-breakers, ammeters, knife switches and watt-hour meters; a Board of Trade panel containing the usual instruments; three power feeder panels, controlling motor circuits, one motor being coupled to a three-throw pump on the sea front, which is used for pumping sea water up to a water tower adjacent to the generating station, and two others are used for driving the water chute and revolving stairway.

There are four machine panels, containing circuit-breakers, ammeters, change-over switches, B.T.H. watt-hour meters and minimum cut-outs; and a motor-generator panel, the top half being on the traction and the other half on the lighting bus-bars.

In the centre of the board are the battery, booster and balancer panels, equipped with change-over and starting switches for the boosters and balancer; starting switches, volt and ammeters, and battery switch levers, operating through a horizontal spindle and bevel-wheels on to the battery switches fixed to the wall behind the board; and to the extreme left of the board are 10 lighting feeder panels equipped with ammeters, knife switches, B.T.H. watt-hour meters, &c.

There is also a small subsidiary switchboard on the engine-room floor for controlling the station and car-shed lighting circuits, and the feed pump and cooling tower fan motors.

The British Thomson-Houston Co. were the contractors for the whole of the switchboard with the exception of the battery and balancer panels, which were supplied by Messrs. Crompton & Co.

The engine room is spanned by a 20-ton hand crane, worked by ropes from the floor level, and constructed by the Chatteris Engineering Co. The boiler house, 85 ft. 6 in. long and 45 ft. wide, is situated at the side of the engine house, and one end, which serves as a pump and condenser house, is partitioned off from the boilers.

There are three Economic boilers by Messrs. Davey, Paxman and Co., of Colchester, each capable of evaporating 6,000 lbs. of water per hour, and it is intended to add another one of 10,000 lbs. evaporation capacity when the extensions are carried out.

The boiler-feeding arrangements include injectors fitted to each boiler, and two Blake-Knowles three-throw pumps, coupled to 4-H.P. Holmes ironclad motors, running at 1,000 revolutions per minute. Each pump is capable of supplying 1,250 gallons per hour. Coal bunkers of 80 tons capacity have been arranged in front of the boilers with a cart road immediately over.

The arrangement of steam piping consists of an 8-in. diameter main, with branches to all the boilers and engines, and a separate branch from each boiler to the nearest engine. The branches are 5 in. diameter; the whole of the steam piping is of wrought-steel, with cast-steel tees, and was supplied by Messrs. Aitken. The valves are of Hopkinson's well-known make.

The exhaust from the engines is carried in a 14-in. cast-iron pipe, laid under the engine room floor, to a Wheeler Admiralty pattern condenser, with the usual steam-driven pumps underneath, situated in the pump room. This is capable of dealing with 15,000 lbs. of steam per hour, and the top rows of tubes are arranged as a feed-water heater. An atmospheric exhaust pipe, 22 in. diameter, of riveted iron plate, is carried up through the boiler house roof, the connection to the main exhaust being made through a horizontal Blake-Knowles relief valve.

An oil filter is inserted in the exhaust pipe adjacent to the condenser, and is connected by a 2-in. pipe with a reservoir below, from which the oil is emptied at regular intervals. As the question of freeing the feed water, from the oil which comes over in the exhaust steam, has excited a good deal of inquiry among municipal electrical engineers, it is interesting to note that Mr. Heenan finds his oil separator sufficiently efficient in practice, to enable the water in the hot well to be pumped direct into the boilers. The water, in the first instance, both for boiler-feeding and condensing purposes, is drawn from the town's supply, a reserve of several thousand gallons being held in supplementary feed tanks.

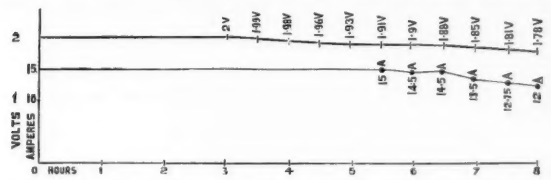
Worldac Battery; Southend Electricity Works.

For steam and electrical testing purposes, a measuring tank in the pump room, and water resistances connected to the switchboard, are provided.

At the end of the boiler house is situated a workshop, equipped with modern tools and a smithy. Over this building is situated a Wheeler-Barnard cooling tower, nominally capable of dealing with 15,000 lbs. of water

per hour, the tank under the tower forming the roof of the building. The cooling tower fan is belt-driven from a Lundell 15-H.P. motor situated in the pump room.

The battery installed in connection with this plant is of more than ordinary interest, being, in fact, the successful



Positive plate 9⅞" × 8⅝" × ¼", weight 6 lbs.; average rate of discharge, 14·5 amps.; average potential, 1·9 volts; total capacity, 116·5 amp.-hours; average efficiency over 10 months' working, 92 per cent.; total watt-hours, 220·5.

Discharge Curve of 5-Plate Worldac Cell.
Plates taken out of Southend Battery after more than 300 discharges.

forerunner of a new type called the Worldac, invented and designed by Mr. A. Schanschieff, of the World's New Accumulator Co., of 32, Victoria Street, S.W.

The defects of the paste type of cell have engrossed the attention of inventors for many years, with only indifferent results. In Mr. Schanschieff's cell, however, the knowledge gained from extended experiments has been embodied, and the patent interlocking grid, composed of two grids rivetted together with the paste in between, effectually prevents the latter from falling out. The patent active material also largely contributes to the successful results so far obtained, combining as it does, internal porosity with external hardness and solidity. Any expansion in the paste is internal, and consequently the plates do not "grow."

Two batteries, each consisting of 132 of these cells, have been running on the Southend lighting and tramways systems since September, 1902. The cells are of glass, and contain 31 plates each, with a capacity of 750 ampere-hours when discharging at a rate of 75 amperes, or 600 ampere-hours at the rate of 120 amperes.

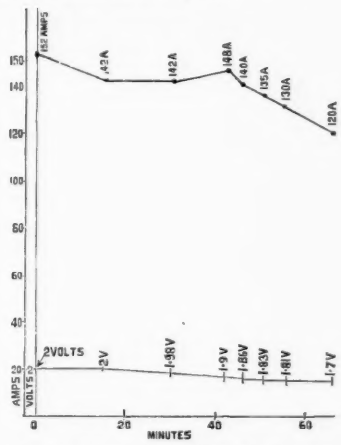
We understand from Mr. Heenan, the borough electrical engineer, that he has obtained an average efficiency of 92 per cent. from the battery during the past 10 months.

Among other points in favour of this type of cell, which have received ample confirmation at Southend, are the exceptionally large capacity, equalling 60 to 70 ampere-hours, as compared with 30 to 50 ampere-hours per 100 sq. in. of positive plate commonly obtained; the ability to rapidly charge and discharge it; in fact, a case of accidental short-circuiting recently occurred to this battery without in any way injuring it; the small amount of attention necessary, no appreciable deposit being present after many months of work. This cell would appear to possess many advantages for other than stationary work, and we understand that its capabilities for road traction have been satisfactorily demonstrated. The combination of such valuable features as large capacity, unlimited range of charge and discharge, with a construction of grid which appears well able to withstand the effects of vibration, should commend itself to those interested in the future of electric traction.

The station buildings also comprise a suite of offices for the staff, and a test room fitted with a potentiometer.

The system of mains covers some 11½ miles of streets, Callender's vulcanised cable laid in bitumen being employed. Four triple-concentric feeders, two of ·3, ·3, ·125 sq. in., and two ·25, ·25, ·125 sq. in. section, supply the distributing main, which is ·125, ·125, ·06 sq. in., triple-concentric throughout.

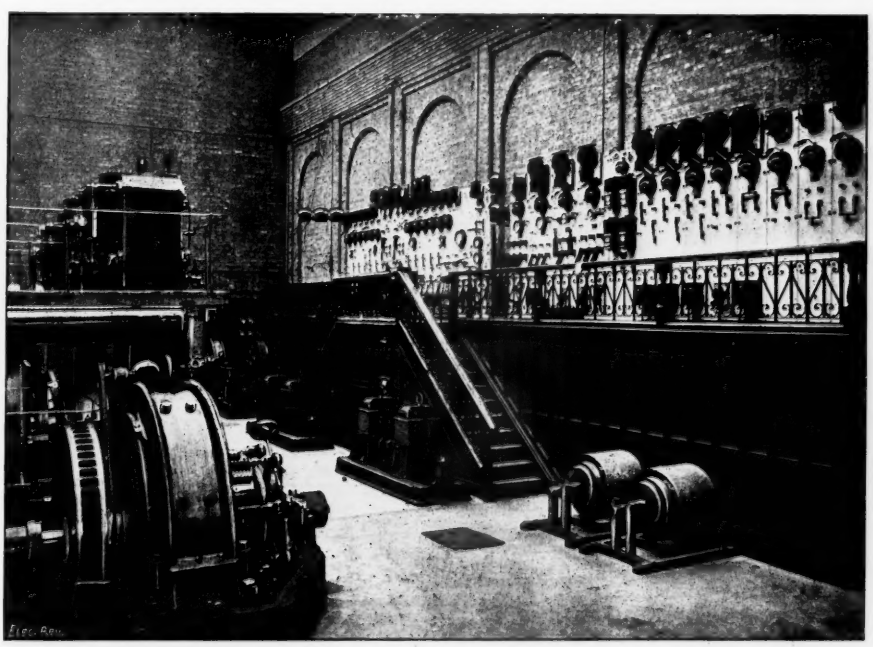
There are 322 consumers on the supply, and the equivalent lamp connections amount to 27,700.



Average current 140 amps.; average potential 1·93 volts; average energy, 270 watts; total time of discharge, 1 hr. 5 mins.; total capacity in power, 151·35 amp.-hours; total capacity in energy, 292·1 watt-hours; area of each plate, 83 sq. in.

Discharge Curve of 11-Plate Worldac Cell.

There are also 60 10-ampere Brockie-Pell arc lamps in use for lighting the principal streets. The arc lamp columns are painted with metallic aluminium paint, and present an exceedingly clean and bright appearance, a feature which we commend to other towns as well worth copying.



Lighting and Traction Switchboards; Balancer, Motor-Generator, &c., Southend Electricity Works.

The maximum lighting and traction loads have reached 385 KW. and 335 KW. respectively, but they do not, of course, occur at the same time.

The total capital expended on the generating plant and cables amounts to £54,000, but the increasing demand for the electric light in the district will necessitate this amount being largely increased during the next year. The amount expended on the light railways and plant amounts to £67,847, and this also will be increased when the Shoeburyness extensions are taken in hand.

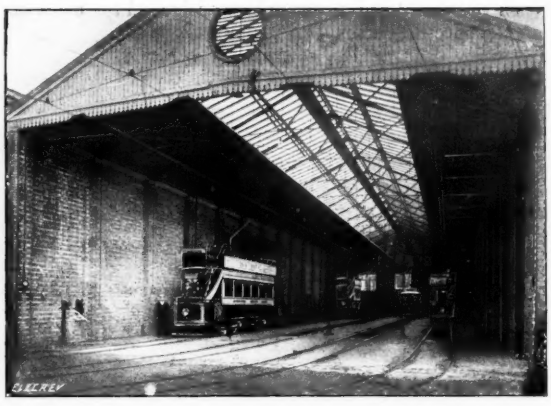
The light railway system, as previously mentioned, was constructed with the generating station under the original contract by Messrs. Dutilh-Smith, McMillan & Co.

The gauge of track adopted is 3 ft. 6 in.; the rails are of

the girder type and weigh 90 lbs. per yard, and the usual construction on a concrete bed has been adopted; Basaltic lava setts being employed between the rails and for the margins. The overhead work formed a sub-contract undertaken by Messrs. Lowden Bros., Dundee. Steel telescopic poles, 9⅝, 8⅝ and 7⅝ diameter are used, and bracket-arm construction. The trolley wire is double throughout, and 000 S.W.G. in size. The overhead work has, to a certain extent, been rebuilt on more modern lines.

Before this occurred, one of the principal crossings in the town had acquired the *soubriquet* of "Cobweb Corner," the suggestiveness of which cannot be denied.

The rolling stock consists of 17 cars, equipped by the B.T.H. Co. and Brush Co. There are two single deck cars, each seating 20 persons; 5 bogie, and 10 single truck



Car-shed; Southend Electric Tramways.

four-wheel cars, with seating accommodation for 58 and 38 respectively.

The car-shed adjoins the boiler house at the generating station, and contains 4 tracks, under which pits have been constructed for examination and repairs. Accommodation is provided for 24 cars, and the shed is shortly to be extended.

The traction feeder cables were, as in the case of the lighting, supplied by Messrs. Callender, and are laid solid, in earthen troughs, all of them being ·2 sq. in. in section. The cables are led into section pillars, from which the overhead line is fed at the usual half-mile intervals.

There are 7½ miles of route, constructed as single track with turnouts, and a further 3½ miles will be added if the Shoeburyness extension is carried out. The maximum gradient is 1 in 18.

In conclusion, our thanks are due to Mr. W. E. J. Heenan, the electrical engineer, and his staff, for their courteous assistance rendered in the preparation of this article, and for the accompanying photographic views of the different departments, which were taken for us by Mr. J. Milton, the mains superintendent.

A NEW ENGLISH CAR.

Before we looked at the signature we knew that the latest solution of the "loading and unloading" difficulty was by a real solid Englishman. He was hall-marked by his English. None but an Englishman could have juggled so wonderfully with the national language.

Many years ago we gave up the notion that a fortune might be ready for the making in one of the miraculous inventions of which we receive gratuitous descriptions by every post, but we still read any which seem to promise a little mirth for our pains.

However, even an earnest desire to smile again was insufficient to carry our dizzy brain through the first closely-written foolscap page of the letter about loading and unloading; and, having been brought up "all standing" by the following sentence, we handed the letter to the latest office boy, whose tramway experience has been gained on the bumpers of cars when the conductor was not looking.

"The long experience I have had with tramways I fail to see especially now that electric traction is in force which has increased tramway traffic and that larger cars are used where this uncivilised way of loading and unloading cars with only an entrance for entering and leaving either at a terminus or along the route, an army of policemen cannot improve it especially cars with the reverse staircases passengers going outside obstruct others from going into the interior." Many a man has succumbed under a lighter sentence than that.

If that sentence were boiled down, we think it would be found that the writer is angry at the absence of a "going-out entrance" on the usual car.

The office boy says, in a corrected form: Mr. —— seems to have invented not only a car, but passengers as well, of a construction as peculiar as his sentences—if, indeed, that which is chaotic can be said to have any construction—for he speaks of the chief obstruction to loading, &c., being "the disorderly public in entering and leaving the cars, because there is nothing to regulate them on the platforms, for instance if there was only one footpath to each road, the obstruction would be '*like a tramcar entrance pushing each other about.*'" The italicised sentence is shown off by inverted commas in the original. The imaginative Mr. Wells has made our flesh creep (strictly out of office hours) by his picture of Martian monsters, but he must yield the palm of originality to this gentleman, who sees men as tramcar entrances, pushing each other about.

After that vision, what was there to surprise in the statement that "to improve loading and unloading, there must be some regulation at the entrance so that passingers can pass each other like two tramcars."

The inventor seems to live in an atmosphere of oaths, and he speaks so feelingly of the conductor that possibly he is one of that long-suffering band.

"On a single track a car has to wait on the loop for the other car to pass, and if a careless driver meets a car on the single line, you have to wait till they have finished swearing at each other, just like the present and old-fashioned tramcar entrances, you have to wait till the passengers leave before you can enter, and if a person gets on the step while another is a getting off, wait till they have finished swearing at each other, especially where the conductor is wedged against the staircase powerless to interfer; but if he is able to, and pushes the person off becase he won't get off the step, he receives a punch on the nose for doing his duty." What a truly shocking and un-Christian state of affairs is disclosed here. A few Salvation Army stalwarts appear to be wanted rather than any mitigating invention by the gentleman who must have had all the English knocked out of him on the badly-conducted system which has roused him to such a pitch of incoherent ink-spilling.

As for the new car, the description is sufficiently nebulous and characteristically worded. Briefly, there are three side-entrances, and "when the car is unloaded the three entrances would be used for entering," which in itself is an admirable scheme, although what follows seems difficult; "this means four could enter the interior and both staircases at one time . . . ." Somewhere in the same sentence it is suggested that one end could be used for "inside smokers." In the name of Munchausen what frightful creatures are these?

The American Street Railway Association.—The annual meeting of this Association opened at Saratoga Springs, N.Y on Wednesday, and closes to-day. The following papers were down for reading:—

"Electric Welded Joints."

"The Evils of Maintenance and Champerty in Personal Injury Cases."

"Train Orders and Train Signals on Interurban Roads."

"Freight and Express on Electric Railways."

"The Manufacture and Distribution of Alternating Currents for City Systems."

"Comparative Merits of Single and Double-Truck Cars for City Service."

"The Right of Way."

ELECTRIC LIGHT AND POWER NOTES.

Ashton-under-Lyne.—The T.C. proposes to adopt a scheme for letting electric motors out on hire.

Aylesbury.—The B. of T. has revoked the electric lighting order.

Bideford.—The Council has decided that the persons who had stated their intention to apply for a provisional order for the installation of the electric light shall be informed that the Council cannot give their consent as they intended themselves to apply for an order.

Brecon.—The B. of T. has revoked the electric lighting order.

Buenos Ayres.—The electrical works of the Primitiva Co. have been leased to the German Co. for a period of 41 years, on the payment of £30,000 per annum; but, on the completion of that period, the works will pass into the possession of the German Co. without further payment. The latter, which now practically controls the whole of the electric lighting works in Buenos Ayres, and also owns the Metropolitan Tramway in that city, was able, for the first time, to pay a dividend last year.

Clydebank.—The plebiscite papers have been sent out by the T.C. to decide the question whether the people of Clydebank are or are not in favour of the burgh carrying out its own electric light provisional order, obtained two years ago; differences of opinion exist as to whether the lighting should be done by the burgh itself or handed over to the Clyde Valley Electric Power Co., who have been in negotiation with the Council on the subject. The papers sent out to the public contained some facts and figures on the results obtained by several burghs of a like size with Clydebank which had set up their own generating stations, as well as extracts from the report of Messrs. Kincaid, Waller, Manville and Dawson, of London, who were asked by the Council to visit Clydebank and give an opinion on the subject of the establishing of a combined dust destructor and electric power house.

Dublin.—As a result of the special meeting of the Municipal Council to consider the reports on the electric lighting of Clontarf and the extra expenditure in connection with Mr. Hammond's scheme, after much discussion both reports were adopted.

Eccles.—The Lighting and Electricity Committee of the T.C. has reduced the price of electricity for lighting purposes from 6d. to 4d. per unit.

Fleetwood.—There is trouble brewing between the Fleetwood Council and the Electric Lighting Syndicate. Mr. Oswin Hanson, the resident engineer to the syndicate, has written to the Highways Committee with reference to the non-supply of electric energy to the public lamps in Radcliffe Road and other streets in the district. In that letter Mr. Hanson states:—"The Receiver and myself have very carefully considered this matter, and as the return does not warrant the expenditure on mains and roadwork, we have decided not to extend the public lighting system beyond what is necessary to fulfil our obligations." The Committee recommend that the clerk be authorised to prepare all requisite notices and requisitions, and to serve the same upon the syndicate, requiring the latter to lay down mains, and to supply electrical energy for lighting public lamps in the streets named, under the powers contained in the Fleetwood Electric Lighting Order, 1890.

Gloucester.—The Corporation has made application to the B. of T. for a prov. order to authorise the Corporation to supply and distribute electricity for public and private purposes within the area of the Gloucester R.D.C., or some part thereof, and the R.D.C. was asked to pass a resolution on the matter.

Guildford.—With reference to the application of the Guildford Electricity Supply Co. to extend their mains to Merrow by means of overhead wires, the clerk read a letter from the company, consequent on the Council's decision to refer the matter to the Surrey County Council, stating that the directors considered that the Council's opinion as to overhead wires being dangerous was entirely wrong, as thousands of miles of such wires were in daily use in all parts of the kingdom, even in crowded thoroughfares, and as no such wires could be erected without the express sanction of the Board of Trade, who issued regulations on the subject, it must be obvious to the Council that no such sanction would be given if the question of danger arose. With regard to the unsightliness, as ordinary telegraph poles would be used, and those on one side of the road only, the wires would scarcely be noticed, and, of course, would bear no comparison to the appearance of the wires and poles used for tramway purposes.

Liverpool.—At a recent meeting of the Electric Power and Lighting Committee a letter was received from the Town Clerk with reference to the postponement of expenditure, where practicable by the committee, until the Money Market is more favourable for borrowng money. At the same meeting the Committee decided to recommend the purchase of condensing plant for the new generating station at Lister Drive for the sum of £11,975.

London.—Sir John Wolfe Barry has issued his award as umpire in the Arbitration which has recently been held to determine the amount to be paid by the London County Council to the Metropolitan Electric Supply Co., Ltd., for compulsory acquisition by the former of the company's generating works at Sardinia Street, Lincoln's Inn Field's. The London Improvements Act, 1899, provided that, in addition to vesting in the company a new site of equivalent area to their present one, the Council were to pay to the company a sum equal to the costs and expenses of erecting and fitting up a new generating station upon a new site with new plant of a capacity to generate and supply electrical energy to an output of not less than 4,000 KW., and all expenses incurred in replacing, relaying, and altering mains. The amount of the award is £183,150.

TOTTENHAM.—Application is to be made to the L.G.B. for sanction to borrow a sum of £70,000 for electric lighting purposes.

HACKNEY.—The Finance Committee of the B.C. received a letter this week from the L.G.B. remitting a surcharge of £209 15s. 1d. made in the audit of the accounts for the half-year ending March 31st, 1902, with respect to expenditure incurred in connection with the ceremony of opening the electric lighting works. The communication proceeded:—"It is not without hesitation that the Board has decided to remit the surcharge, having regard to the nature of some of the items included in the sum disallowed, and it must not be expected that the Board will adopt a like course with regard to the disallowance and surcharge of any similar expenditure hereafter incurred." The same Committee has also received a letter from the L.C.C. sanctioning the borrowing by the B.C. of £6,500 for boilers for the electric light undertaking.

WESTMINSTER.—The City Council has decided to extend its system of electric lighting from Exeter Street, Strand, the boundary of the parish of St. Martin's-in-the-Fields, to the Law Courts, and also to light by electricity the new thoroughfares of Kingsway and Aldwych. The lamps will be fixed alternately on either side of the thoroughfare at a distance of 35 yards, on the "islands" in the centre of the roadway, and round the churches of St. Mary-le-Strand and St. Clement Danes. The Council will erect the standards and provide the fittings, and energy will be supplied under contract by the Charing Cross and Strand Electricity Supply Corporation, Ltd.

Lowestoft.—An inquiry has been held by the L.G.B. into the application of the T.C. for sanction to the borrowing of £2,000 for extending the electricity mains.

Malton.—The Northern Counties Electricity Supply Co. has addressed a letter to the Urban Council stating that it has decided to erect a generating station at Norton. The Council objected strongly to the establishment of a station at Norton, as the original order specifically provided that it should be at Malton.

Newcastle.—The Guardians have under consideration a £15,000 scheme for re-lighting (electric) and hot-water heating at the Union Workhouse.

Newport.—The Ratepayers and Property Owners' Association has intimated to the Local Government Board that it intends to oppose the application of the Corporation for leave to borrow £58,000 for providing additional electrical plant.

Newton.—No objection will be offered by the Rural Council to Edmundson's Electricity Co. extending their mains to Kingsteignton for the purpose of lighting that village.

Oldham.—The Electricity Committee has decided to reduce the price of energy to places of worship to 3d. per unit, no distinction being made between Sundays and week-days.

Ormskirk.—The Board of Trade has intimated that it has deferred the consideration of revoking the provisional electric lighting order until December 31st.

Porthcawl.—At a meeting of the Council a letter was read from the secretary of the British Electric Lighting Co., stating that the company intended to apply for a prov. order for supplying electric light in the district, and inquiring whether there was any likelihood of opposition on the part of the Council.

Redditch.—A special meeting of the U.D.C. was held last week, the chief purpose being to confer with Mr. Monkhouse, of Messrs. Burstall & Monkhouse, London, the expert employed to report upon the condition and prospects of the undertaking. Abstracts from the principal and supplementary reports of Mr. Monkhouse have already been given in our columns. After consideration of the principal and supplementary reports the Council decided upon taking action as follows:—1. That provision be made in the new loan for (*a*) the mechanical starting gear recommended in Clause 4 of the report of June 26th (estimated cost £55); (*b*) four sets of wattmeters (estimated cost £180). 2. That the works manager obtain particulars and report upon the provision of watertight ventilated covers and frames for the transformer chambers. 3. That the works manager report every month as to the oil, fuel and stores required at the works. It had also been decided that the matters to be discussed with Mr. Monkhouse were:—(1) Paragraph 14 of report, and answer to Question No. 7 as to adapting the gas plant for working with bituminous coal; (2) Paragraph 12 of report as to works costs; and (3) answer to Question No. 5 as to charges for current for motive power. Paragraph 14 of the report read as follows:—"Besides the consumption of fuel being high, the cost is also high, and this is due to your having Dowson gas producers, and having to use therein anthracite coal and coke. We understand that you could get bituminous slack delivered at Redditch at about 7s. 6d. per ton. As there are now producers on the market which will

work with this slack, we think you would do well to consider whether you should not adapt your gas plant for working with bituminous coal, as great economy might possibly be effected."

Mr. Harbon pointed out that last year they used 800 tons of anthracite at 17s. 9d. per ton, and 225 tons of coke. If they could get equal results by the use of bituminous coal it represented an enormous saving.

In the course of further discussion it was pointed out that the use of the bituminous coal would mean a saving of about £400 per annum.

Mr. Monkhouse stated that bituminous producers were in use at Messrs. Cadbury's, Birmingham, and also at Messrs. Allbright and Wilson, of Birmingham, and with the best and most satisfactory results. There was, he added, no more smoke with bituminous than with anthracite coal, and little more smell. The producer would never have to be put out to "clinker" it, and there would be no waste in starting. It was partly this consideration which led him to recommend the bituminous coal, as the system was running continuously. He strongly recommended the Council to make the alteration, and adopt the gas plant for the use of bituminous coal, provided the capital outlay was not too heavy.

Mr. Moule asked if they used bituminous coal at Walthamstow, where it was shown they were making a profit.

Mr. Monkhouse replied that at Walthamstow they used anthracite. But each place must be considered on its own merits, as the prices for the coal varied greatly in different localities. Near London the prices of bituminous and anthracite did not greatly differ, whereas at Redditch the prices would be very different. The use of bituminous coal was not by any means a new thing, but it was comparatively new to use it in connection with gas engines. On the question of works cost, Mr. Monkhouse considered the labour was high. He understood a great deal of repairing had been done at the station, which was necessitated by causes beyond the present staff's control. That work had been charged to revenue, which in a large measure accounted for the high cost of wages.

In reply to further questions, Mr. Monkhouse stated that it was not necessary to make any allowance for depreciation if the plant was maintained in good working order out of revenue. He also said there would be no need for any addition to the existing staff. He recommended that the sale of energy for motor purposes at present prices (1d. to 2d. per unit) be continued, as in any case the plant had to be running continuously during the day, under the alternating current system.

St. Helens.—The L.G.B. has sanctioned the borrowing of £3,440 by the Corporation for electric lighting purposes, the period of repayment being 21 years, but they have, in accordance with their usual practice, excluded the sum of £80 representing the amount of debt outstanding in respect of the work to be superseded.

Sheppy.—At a meeting of the R.D.C. the clerk mentioned that the Isle of Sheppy and District Electric Light Co. were seeking powers to supply electric light in Queenborough and the Isle of Sheppy. Provisional orders have been approved by the Board of Trade and they now received the sanction of the Council.

Southport.—The enlargement of the electrical substation at the Cambridge Hall, Southport, is now completed. The station serves the Town Hall, Cambridge Hall, and the rest of the municipal buildings, together with the illuminations of the municipal gardens. Three high tension feeders have been laid and the station is fireproof. The former transforming station under the Town Hall has been transferred to the station in Eastbank Street, which now serves the greater part of Lord Street.

Stourbridge.—At the last Council meeting the Destructor and Railway Committee reported that the B. of T. had consented to extend the term of the provisional order by one year. The Committee recommended that the electric lighting plant be laid down on the land recently purchased and adjoining the main drainage pumping station, in combination with the proposed refuse destructor. The report was adopted, and the Committee authorised to obtain plans and estimates for a combined scheme for the electric lighting plant and a refuse destructor.

Swinton and Pendlebury.—The street lighting here has long been unsatisfactory, and the erection of the tramway poles on the footpaths has tended to make matters worse than ever. In many places the poles completely block the gas lamps, and along the Bolton, Manchester, Chorley and Station Roads the electric car drivers complain that they are unable to see their way. They have evidently acquainted the tramways manager of their difficulties, and a letter has been received by the District Council from the Salford Tramways Committee, complaining of the inefficient lighting, which increases the danger of accidents. The humour of the position is that the Salford Corporation supply the gas with which Swinton and Pendlebury are lighted, so that really one department of the Royal borough is complaining of the work of another. The Swinton Council have, however, appointed a Sub-Committee to consider the whole question of improved lighting, which, it is universally agreed, is much desired.

The U.D.C., whose prov. order for electric lighting expires in October, is negotiating with the Lancashire Electric Power Supply Co. and the South Lancashire Electric Tramways Co. for a supply of electricity in bulk. The Council will provide its own distributing plant.

Trowbridge.—The U.D.C. on Friday received from the B. of T. correspondence relative to the Council contracting with a private company for the execution and maintenance of electric light works, and it was decided to reply that the Council did not intend to divest itself of its legal powers under the prov. order, the intention being to contract with a private company to construct works, the Council to have the option of purchase at certain periods. It was also announced that the B. of T. had stated that it was unable to extend the prov. order.

Warrenpoint.—The U.D.C. has rejected a proposal to apply for a prov. order to enable it to provide a system of private and public lighting.

Wimbledon.—The U.D.C. last week adopted a report from the Electric Lighting Committee recommending that the Local Government Board be asked to sanction a loan of £11,000 to be expended on the following works to supply electricity in Merton:—Sub-station depôt at Blenheim Road and equipment, £200; high-tension feeder from "B" sub-station, £1,050; low-tension distributor in Grand Drive and Blenheim Road, £410; low-tension distributor from Raynes Park sub-station, £380; underground sub-station, high-tension feeders from the works and low-tension distributors, £4,935; 25 low-tension distributors from the Merton sub-station along the south side of Kingston Road, £600; cables, £3,000; contingencies, £425. The chairman stated that so far as municipal enterprise went the monetary success of the Wimbledon electric lighting undertaking was unparalleled throughout the country. In spite of having to pay large sums for preliminary expenses, which ought properly to have been charged to capital account, last year there was a profit of £1,400, while this year the profit was £2,000. The electrical engineer reported favourably upon a proposal to utilise water from the river Wandle for the purposes of the works, and estimated the cost of the necessary water-softening and storage plant at £1,300. It was resolved to apply to the Local Government Board for a loan for this amount.

Woking.—The work of installing the electric light at Woking Junction Railway Station and yard is making rapid progress. Energy is to be supplied by the Woking Electric Supply Co., Ltd., who are laying a main to the railway company's electric substation near the east signal box. They will supply at 2,000 volts, and here their responsibility will cease. The L. and S.W.R Co. are building their own sub-station and doing the whole of the cable laying and wiring on their property. The improved system of lighting will be of great benefit, both to passengers using the junction and the staff employed in the busy shunting yard, where the more powerful illuminant will tend to minimise the risk of accident.

Worthing.—The Local Government Board has held an inquiry with reference to the application of the T.C. for sanction to borrow £2,835 for electric lighting purposes. There was no opposition.

ELECTRIC TRACTION NOTES.

Birkenhead.—The second annual report of the working of the Birkenhead Corporation tramways has been issued by Mr. A. R. Fearnley, general manager. It records that during the year halfpenny stages were introduced, and that the new tramway offices in Laird Street were opened on July 28th last. The number of passengers carried was 10,390,985 against 6,456,361 in 1901-2, and the income £52,876 compared with £31,593. The working expenses were £30,367 against £19,053. Units of electricity consumed, 1,953,095, against 982,737. Income per mile, 9·92d., against 10·54d. Working expenses, 5·69d., against 6·36d. The net profit is returned as £3,598 against £3,514.

Bradford.—A heated controversy has arisen at Bradford over the matter of the increase of the salary of Mr. C. J. Spencer, the tramways manager, which was approved at the last Council meeting. So strongly is feeling running against the increase—upon which there is almost a clear division of political parties—that certain Councillors have had to convene public meetings to defend their action in voting for it; and it is said that a motion to rescind the resolution is to be moved at the next Council meeting.

Coatbridge, N.B.—After some delay a start has been made with the construction of the Coatbridge and district electric tramways. The lines are to be completed by February next.

Denmark.—The Danish State Railway authorities propose to convert their branch lines to electric traction. Designs for locomotives or motors will be invited towards the end of the autumn.

Halifax.—The Corporation has, in connection with the project of extending the electric tramway system to Brighouse, decided upon the following outlay:—4,330 yards of high tension cable, estimated cost, £2,091; 4,330 yards of pilot cable, £388 13s. 6d.; 4,330 yards of excavating and reinstating, £433; 3,000 yards of low tension cable, £853; 3,000 yards of excavating and reinstating, £300; total, £4,066.

Heywood.—The T.C. proposes to purchase that portion of the Bury, Rochdale and Oldham Tramway Co., Ltd., which is in the borough, and a meeting of the Council is to be held on September 28th to pass a resolution to that effect. If the lines are taken over they will be electrified.

Huddersfield.—Some criticisms having been made by the Board of Trade's inspecting officers and electrical adviser with regard to the construction and equipment of electric tramcars, the manager of the Corporation's service (Mr. H. N. Thomas) has submitted his comments thereon to the Tramways Committee, and, for

the most part, they are of a favourable character. Mr. Thomas considers the suggestion that the steps should be designed so as to fold up at the front end of the car, is very practicable. More injury, he says, is done to the person who is knocked down by the presence of the step than by anything else. Reversed staircases are condemned by the Board, and the Huddersfield manager says he has always been opposed to this class of car, as they limit the view of the motorman. He agrees that the distance between the hanging gate and the life-guard proper should be quite 3 ft. With regard to trolley ropes, which the Board say should be prevented from jumping, and measures adopted to take up the "slack," Mr. Thomas states that the Huddersfield cars are all fitted with Majrini trolley cord governors, which effectively control the cord. An adjustable stop on the trolley standard is recommended so as to limit the rise of the boom if the trolley leaves the wire, but Mr. Thomas says this must be governed entirely by local requirements. In his opinion, it is almost an impossibility to limit the rise of a boom to an inch or so in order to prevent it striking, say, a bracket arm. He concurs in the suggestion that a half sleeve with four bolts is preferable to a split casting for the attachment of trolley booms. He also agrees, with regard to trolley standards, that anchoring of the bracket arm is preferable to doing so with the trolley wire, although he states that in Huddersfield there has not been any tearing out of the trolley standards. The Board of Trade criticisms upon which Mr. Thomas's remarks are based are printed on another page of this issue.

All the Corporation tramcars have been fitted up with the Westinghouse-Newall magnetic brake, which is giving satisfaction. A number of bogie cars are being converted into truck cars, it having been found that the bogie car with the double motor equipment is totally unsuited for hill climbing on grades such as prevail in Huddersfield.

Liverpool.—A return which has just been issued shows that in the first six months of the present year upwards of 60,000,000 passengers were carried by the electric cars of Liverpool, and without a single fatal accident occurring. The total given represents the carrying of the population of the city 1¼ times each week. On an average 7,500 electric cars pass in and out of the city each day. The returns continue to show that the electric tramways are less dangerous than the old horse cars were. In 1898, with horse cars in use, for 10 months out of the 12, there was one fatal accident for every 6,000,000 passengers carried; in 1899, with electric cars, the fatalities were at the rate of one in 8,000,000; in 1901, they were one in 11,000,000; in 1902, one in 13,000,000; and in the first six months of 1903 there was no fatality and 60,000,000 passengers were carried. This freedom from fatalities is attributed largely to the use of the plough lifeguard, which was introduced by Mr. C. R. Bellamy, the general manager, about two years ago.

London.—While the new electric tramways on the Tooting lines are proving a great success, some difficulty is being experienced, so the *Daily Chronicle* says, in connection with the altered arrangements on the Streatham cable route. Pending the electrification of this line, the County Council decided to have certain of the new electric cars fitted with special apparatus, so that they could be run from the termini at the bridges to Kennington by means of electricity and then over the existing route from Kennington to Streatham by cable. Doubts were freely expressed as to whether the cable was sufficiently strong to stand the extra strain of the new cars, which are much larger and heavier than the old ones, and these fears have since been justified. Of the 20 electric cars fitted for working on the combined systems about 10 or 15 have been running daily during the past two or three weeks, and observations go to prove that the added strain of a large number of cars would be too much for the cable. It is understood, therefore, that the original scheme for combining the cable and electrical systems is to be abandoned, and it may be confidently expected that the conversion of the cable route to electric traction will be pushed on as soon as possible.

Paris.—It is reported from Paris that the Committee of the Municipal Council which was appointed to inquire into the condition of the Metropolitan Railway after the recent catastrophe, has completed its report, which recommends that the present system of motor-cabs on each train shall be abandoned, so that in case of fire the engine can be isolated immediately, and that the carriages shall be made of incombustible material. Several minor improvements are also recommended.

The Paris Metropolitan Railway is about to increase its capital from £2,000,000 to £3,000,000. It is said that, notwithstanding the heavy fall in the traffic receipts as the result of the recent disaster, there will be no trouble in raising the money, as it will be subscribed entirely by the existing shareholders.

Prestwich.—The U.D.C. has applied to the B. of T. for a loan of £24,125, for the construction of electric tramways in Bury Old Road. The line will join the system from Salford.

Northampton.—The Tramways Committee last week opened the tenders for the electrification of the tramways. The tenders are about 100 in number, and several firms sent in prices for the whole of the work. The estimate of the borough surveyor, Mr. A. Fidler, was that the work would cost £85,000. One firm, tendering for the whole of the work, has sent in two prices, £85,292 and £84,292, but guarantees that the acceptance of the higher or the lower tender will make no difference in the quality of the material used. Moreover, it guarantees that everything put into the work shall be of British manufacture, and that the contract shall be completed by March 31st next. It is stated that the total amount of the lowest tenders for doing the work in sections is higher than the lowest tender of this particular firm. The Board of Trade in sanctioning the application for the loan for carrying out the work, stipulate that the loan for the cars shall be repaid within ten years, the loan for the plant within 20 years, and the loan for the permanent way within 30 years. The committee were desirous that the whole of the repayments should extend over 30 years. If the loans are repaid as suggested by the Board of Trade, the amounts to be set aside for the payments of interest and repayments of principal will during the first few years be considerably heavier than was anticipated. It is said that without a Sunday service it will hardly be possible to make the tramways pay under the conditions which the Board of Trade have named regarding the loan. The Finance Committee meets in a few days to discuss the letter from the Board of Trade, and this meeting will be followed by a meeting of the Tramways Committee.

Southend.—The Southend-on-Sea and District Light Railways (Extensions) Order has been submitted by the Commissioners to the Board of Trade for confirmation.

South Shields.—The Council on Wednesday had before it a series of resolutions having for their object the electrification of a number of tramways to be worked municipally, and instructing the Tramways Committee to have plans and estimates prepared and tenders invited, so that application may be made for the necessary loan.

Tottington.—The U.D.C. has given notice to the local tramway company that it intends to acquire so much of their undertaking as lies in the Council's district. The lines will be worked in conjunction with the Bury Corporation electric tramways under a 21 years' lease.

Worcester.—In spite of the opposition of the T.C., the B. of T. has granted the B.E T. Co. and the Worcester Tramways Co. an extension of six months in which to complete the electrification of the tramways.

TELEGRAPH AND TELEPHONE NOTES.

New Zealand.—According to the annual report of the New Zealand Post and Telegraph Department, there are now 26 central telephone exchanges and 44 sub-exchanges in New Zealand, an increase of three and nine respectively on the year. The length of telephone wires in use in the colony is 8,727 miles, an increase of 960 miles.

Telegraph Rates to the Far East.—Certain reductions are announced in the rates for telegrams to China, Korea, Formosa, Japan, and the Philippines, *viâ* Turkey.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1900	
Trinidad-Demerara No. 1	Aug. 27, 1901	
Trinidad-Demerara No. 2	Aug. 26, 1903	
Dominica-Martinique	May 8, 1902	
St. Lucia-Martinique	May 8, 1902	
Guadeloupe-Martinique	May 9, 1902	
Martinique-Puerto Plata	July 10, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
St. Lucia-St. Vincent	Sept. 19, 1902	
Reissa-Issa	Oct. 22, 1902	
Reissa-Yemani	Oct. 22, 1902	
Paramaribo-Cayenne	Feb. 27, 1903	
New York-Haiti	April 13, 1903	
Fao-Bushire	July 28, 1903	
Bolama-Bissao	Aug. 4, 1903	
Antigua-Guadeloupe	Aug. 9, 1903	
Mozambique-Madagascar	Aug. 19, 1903	Sept. 1, 1903
Landlines.		
To Puerto Barrios	July 28, 1903	
Rome-Pera	Aug. 7, 1903	

Wireless Telegraphy.—The Marconi wireless telegraph arrangements for reporting the yacht race on August 25th were rendered nugatory by, it is said, the machinations of rivals. Mr. Melville Stone, general manager of the Associated Press, says that the whole affair resolved itself into a contest between competing companies and systems. When one found that it was unable to transmit messages it forthwith did its best to spoil the others. Mr. Bentley, manager of the Marconi Co., in his explanation said that there were 10 separate stations from and to which the race was to have been reported. "We were able to cut out all our rivals except one. That one had a high-power land station, which switched on still more power on Tuesday, and incessantly sent A B Cs from 9 o'clock in the morning until 5 o'clock in the evening, varying this with long extracts from Longfellow's poem 'The Wreck of the Hesperus.' That just killed our messages."—No doubt in spite of this we shall be again told directly that the messages cannot be interfered with.

Mr. Marconi is reported to have been holding interviews with Edison respecting four inventions he has recently made for improving his system, one being a method of reducing by one-half the high power now necessary for transmitting messages.

A *Times* report from Lagos says that the Legislative Council has passed a law making it a penal offence to introduce wireless telegraphy into the colony without the sanction of the Governor in Council.

The latest Marconi promise, according to Dalziel, is that "within three months he would send messages of any length by wireless telegraphy from Canada to England." "He was about to take legal advice in regard to the interference by others with wireless telegraphy."

CONTRACTS OPEN AND CLOSED.

OPEN.

Belgium.—October 3rd. The Municipal Authorities of Liège are inviting tenders until October 3rd for the supply of six electric tramcars. Particulars may be obtained from, and tenders are to be sent to, Le Bureau Administratif des Travaux, à l'Annexe de l'Hotel de Ville, Liège.

Bermondsey.—September 21st. Dust destructor plant, 300-kw. steam generators, feeder boosters, motor balancer, switchgear, cables, &c. See "Official Notices" to-day.

Brisbane.—September 30th. The deputy Postmaster-General is in the market for certain postal and telegraphic material.

Croydon.—September 14th. Buildings, smiths' and ironfounders' works for the electricity works extensions. See "Official Notices" to-day.

Cuba.—September 28th. Tenders are being invited until September 28th by the municipal authorities of Cienfugos for the concession for the electric lighting of the public streets and buildings of the town.

East Indian Railway.—September 9th. The East Indian Railway Co. invites tenders for the supply and delivery of:—(1) Engine turntables; (2) Electric overhead travelling cranes, &c.; (3) Electric pumping installation; (4) Steel material; and (5) Feeder panel, insulated cables, &c, as per specifications to be seen at the company's offices, Nicholas Lane, London, E.C.

France.—September 10th. Tenders are being invited until September 10th by the French Post and Telegraph Authorities for the supply of 12 kilometres of submarine electric cable core, and 190 tons of bronze or copper wire. Particulars may be obtained from, and tenders are to be sent to, Le Sous-Secretariat d'Etat des Postes et des Telegraphes, 103, Rue de Grenelle, Paris.

Greece.—September 10th. The Municipal Authorities of La Canée are inviting tenders until September 10th for the electric lighting of the town.

Holland.—October 1st. Tenders are being invited by the municipal authorities of Utrecht for the construction and equipment of a central electricity station for lighting and power purposes, and for the working of a tramway.

Holland.—The Dutch Post and Telegraph Authorities in The Hague have just called for tenders for the laying of telegraph cables under water between Amsterdam and Harlem.

Johannesburg.—October 19th. Gas producer plant; gas engines and dynamos. Alternative:—Water-tube boilers, steam engines or turbines, electric generators, and other plant. For the municipal tramways and electrical supply scheme. See "Official Notices" August 28th.

Launceston (Tasmania).—September 28th. 500 or more electric meters. See "Official Notices" June 12th.

London.—October 6th. Four 5,000-h.p. vertical-horizontal steam engines, each suitable for driving a three-phase generator, for the Greenwich power station. See "Official Notices" July 24th.

Merthyr Tydfil.—September 12th. Hills Plymouth Co., Ltd., invites tenders for stores for the 12 months ending September 30th, 1904. The following are some of the items:—India-rubber, asbestos, &c.; steam tubes and fittings; electric appliances.

Pietermaritzburg.—September 7th. Poles and overhead equipment for the Corporation tramways. See "Official Notices" August 21st.

Portugal.—October 21st. Tenders are being invited until October 21st by the Portuguese Ministry of the Colonies in Lisbon for the concession for the electric lighting of the town of Macao in the Portuguese Colonies.

Radcliffe.—September 5th. Tramway and lighting feeders, cables, conduits and accessories. See "Official Notices" August 21st.

Reigate.—September 17th. Water-tube boiler, piping, 200-kw. steam alternator, switchboard and instruments, condensing plant, cooling tower, &c., for electric lighting. See "Official Notices" to-day.

Rochdale.—September 26th. Electrical work at the Dearnley Workhouse. See "Official Notices" to-day.

Salford.—September 19th. High-tension cable. See "Official Notices" to-day.

Southend.—September 14th. Steam dynamo, boiler and condenser for the electricity works. See "Official Notices" August 28th.

Spain.—September 12th. The Municipal Authorities of Plencia (province of Vizcaya) are inviting tenders until the 12th inst., for the concession for the electric lighting of the town during a period of 4 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Plencia (Vizcaya).

Stoke-upon-Trent.—September 11th. Pipe-work, non-conducting covering, and water-softening plant for the electricity scheme. See "Official Notices" August 21st.

Sweden.—October 15th. Tenders are being invited by the municipal authorities of Gelfe until October 15th for the supply of six electrical cranes.

Whitechapel.—September 12th. Electric lighting of a portion of the Infirmary. See "Official Notices" August 28th.

CLOSED.

France.—The French Post and Telegraph Authorities in Paris have just given out a number of contracts as follows:—La Société Industrielle des Telephones, Paris, 7,210 metres of lead-insulated 21 pair conductor telephone cable; 18,000 metres telephone cable ditto (27 pairs conductors); and M. Grammont, of Pont de Cheruy (Isere) 10,000 metres ditto (27 pairs conductors.)

Halifax.—The Corporation has accepted the tender of the British Insulated and Helsby Cables, Ltd., for the supply of feeder cable at £759. The Electricity Committee has accepted the tender of Pollit & Wigzell, Ltd., for a patent horizontal air pump with condenser for £228.

Sydney (N.S.W.).—The City Council received the following tenders for arc lamps and posts:—

Messrs. Pope, Maher & Co., Darlington Ironworks	£10,399 12 0
Messrs. Siemens Bros. & Co., O'Connell Street	10,720 0 0
Messrs. Mountney & Co., Ltd., Pyrmont	10,949 9 6
Messrs. Crompton & Co., Ltd., George Street ..	11,009 14 0
Henley's Telegraph Works Co., Ltd., Kent Street	11,215 7 1
Mr. R. T. Ball, Allen Street, Ultimo	11,525 10 0
Henley's Telegraph Works Co., Ltd.	11,911 4 10

The Council, on the recommendation of the Committee, resolved "that the tender of Messrs. Pope, Maher & Co. for the supply and erection of posts, arc lamps, &c., in the sum of £10,398 4s. in nine months, be accepted, and that they be required to supply Messrs. Crompton & Co.'s lamp."

FORTHCOMING EVENTS.

Wednesday, September 9th.—Meeting of the British Association for the Advancement of Science opens at Southport.

NOTES.

Three-phase Machinery in Mines.—The following is an extract from last week's issue of the *Colliery Guardian* in reviewing the *Engineering Magazine*:—"An article of considerable interest is contributed to the current issue of this magazine by M. Emile Guarini, describing some 'Electric Power Appliances in the Mines of Europe.' We have recently heard much concerning the elaborate electrical installations at work in Continental mines, and British mining engineers have been led to believe that the three-phase system is being adopted abroad to the exclusion of the direct system. This appears to be very far from being the case. Germany is far ahead of other countries in the application of electricity to mining, and, according to M. Guarini, three of the largest firms of manufacturers in that country—the Allgemeine Elecricitäts Gesellschaft, the Union Electricitäts Gesellschaft, and the Helios Co.—still favour the continuous current, whilst Messrs. Siemens & Halske advocate the alternating current type of motor." In view of the discussion on three-phase plants for power transmission in mines at the recent meeting of the Institute of Mining Engineers, and the advocating of three-phase machinery in this country by some engineers, this will prove interesting reading to mining engineers, especially to those who may have some inclination to adopt three-phase plant. "The author himself preserves an impartial attitude, but considers that, whilst the decision must depend finally on circumstances, the advantage in the main rests with the triphase whenever the central generating station is situated far from the actual point of attack." We would point out that this has already been claimed in an article recently published in this journal.

St. Louis Exposition.—The *Financial Times* quotes Mr. James Weir, of Messrs. G. & J. Weir, of Cathcart, Glasgow, who has been in America lately, as saying that "scarcely a solitary British manufacturer of repute would exhibit at the St. Louis Fair because their designs would be stolen by American firms. There will be some general exhibits from Europe, but all manufacturers in France, Germany and Great Britain would positively refuse toexhibit."

American Electro-Therapeutic Association.—This enterprising and useful Association holds its 13th annual convention at Atlantic City, N.J., on September 22nd, 23rd, and 24th. It will doubtless interest electro-medical readers on this side to know the topics that are coming before the meetings:—

Reports of Standing Committees.—On Induction Coils and Alternators, by Margaret Abigail Cleaves, Chairman.

On Electric Light Apparatus for Diagnosis and Therapy, and the Roentgen Ray, by William Scheppegrell, Chairman.

On Electrodes, by R. G. Brown, Chairman.

On Meters, by Robert Reyburn, Chairman.

On Cataphoresis, by Fred Harris Morse, Chairman.

On Static Machines and Condensers, by William Benham Snow, Chairman.

On Constant Current Generators and Controllers, by William James Herdman, Chairman.

On Current Classification and Nomenclature, by William Johnson Jenks, Chairman.

On St. Louis Exposition in 1904, by William Benham Snow, Chairman.

Papers.—"Electrotherapy as a Speciality." Alfred William Bayliss, Buffalo, N.Y.

"Currents of High Frequency, Apparatus, and Therapeutic Uses," Francis Goodwin DuBose, Selma, Ala.

"The Effects of the Secondary Static Currents in Removing Albumin and Casts from the Urine," Boardman Reed, Philadelphia, Pa.

"Some Principles upon which is Based the Use of Electricity in Nervous Diseases," Alfonso David Rockwell, New York, N.Y.

"The Use of Electricity in the Treatment of Diseases of the Heart," Sigismund Cohn, New York, N.Y.

"Electricity in the Treatment of Diseases of the Stomach," Harvey Hamilton Roberts, Lexington, Ky.

"Electricity in the Treatment of Chronic Deafness," George Zena Goodell, Salem, Mass.

"Employment of Static Electricity in the Treatment of Nervous Diseases," William Benham Snow, New York, N.Y.

"Electrical Treatment of Trachoma and Corneal Opacity, with Illustrative Case," Margaret Abigail Cleaves, New York, N.Y.

"The Successful Treatment of Eighteen Cases of Granular Lids by the X Ray and High-frequency Vacuum Electrodes," Albert Charles Geyser, New York, N.Y.

"A Year's Work in Electro-therapy," Laura Viola Gustin-Mackie, Attleboro, Mass.

"The Treatment of Urethral Stricture and Fissure of the Anus by Electrolysis, with Report of Cases," John Clark Luke, Ocilla, Ga.

Problems in Electro-Therapeutic Practice; a General Discussion.

"Treatment of Tuberculosis, with Report of Cases," Russell Herbert Boggs, Pittsburg, Pa.

"The X Rays in the Treatment of Tuberculosis of the Throat," William Scheppegrell, New Orleans, La.

"The Röntgen Ray in the Treatment and Cure of Cancer, Lupus, Rodent Ulcer and Eczema, with Histories of Cases Treated," Elijah Wilkinson Smith, Terra Haute, Ind.

"The Use of the X Ray in the Treatment of Malignant Growths, with relation of Cases," Marcus Morton Johnson, Hartford, Conn.

"The Position of the Röntgen Ray and Ultra-Violet Light in the Therapeutics of Malignant Diseases of the Uterus and Adnexa," Margaret Abigail Cleaves, New York, N.Y.

"The Type of Cell and Pathological Features of Carcinoma which do not Respond to X Ray Therapy," William Leroy Kenney, St. Joseph, Mo.

"The Present Status of X Ray Therapy in the Management of Cancer," Clarence Edward Skinner, New Haven, Conn.

"The Use of Galvanic Electricity in the Treatment of Cancer and Kindred Diseases," William Winslow Eaton, Danvers, Mass.

"Radio-histo-fluorescence," William James Morton, New York, N.Y.

"Cataphoresis," James C. Gill, Chicago, Ill.

"The Röntgen Ray as an Aid in Diagnosis," Herman Grad, New York, N.Y.

"Perineuritis," Almerin Webster, Baer, Chicago, Ill.

"Nerve Health and Nerve Debility: the Effect of the Actinic Rays upon Tissues," Albert E. Sternes, Indianapolis, Ind.

"Retrospect of the Second International Congress on Electro-Therapeutics at Bern," Robert Newman, New York, N.Y.

"A Plea for Electro-Therapeutics Proper," William James Herdman, Ann Arcor, Mich.

"A Plea for an Accurate and Scientific Method of Röntgen Ray Treatment," Mihran Krikor, Kassabian, Philadelphia, Penn.

"Exophthalmic Goitre and its Rational Treatment with exhibition of the Broom electrode," Francis Besant Bishop, Washington, D.C.

"Some Therapeutic Indications for the use of the Radiant Light Bath," Thomas Davidson Crothers, Hartford, Conn.

"Some New Points in the Treatment of Tuberculosis," Wolff Freudenthal, New York, N.Y.

"Electro-Therapeutic Gleanings," Jefferson Demetrius Gibson, Birmingham, Ala.

"A Case of Asthma with Fibroids and Pelvic Adhesions, cured by Galvanism," Charles Augustine Covell, New York, N.Y.

The Victoria Falls.—At a meeting of the African Concessions Syndicate held in London last week, the chairman gave a very glowing account of what is expected from the great Victoria Falls when the scheme for their electrical utilisation takes more practical shape. He gave comparative figures of the Niagara and Victoria Falls, bringing out the greater magnitude of the latter. The benefits to be conferred upon the development of mining and other industries by electrical transmission need hardly be dwelt upon at length here, so palpable are they to the reader; but if electrical transmission can be successfully adopted for a distance of, say, 300 miles, a most important area will be available for electrical mining, railway and other work. When the railway is completed to the Falls, as it is expected to be by the middle of next year, the company is going to send forward surveying expeditions. After that a power company will be formed whose initial outlay will be at least half a million sterling.

Halfpenny Tram Fares.—A report on this question has been submitted to the Glasgow Corporation Tramways Committee by Mr. John Young, the general manager. As an outcome of inquiries addressed to over 50 corporation tramway managers throughout the country, Mr. Young arrives at the conclusion that the opinion of the various corporations is not at present generally favourable to the adoption of halfpenny fares, although seven of them, including Glasgow, have such fares in operation over their whole systems; nine, including Leeds, Halifax and Ilkeston, have halfpenny fares on certain stages; and four or five others issue halfpenny tickets to workmen. Mr. Young accordingly recommends no change in the present stages and fares at Glasgow.

Tube Railways: An Idea.—The accompanying illustration represents the protective equipment suggested for the use of passengers on the Paris underground electric railway by the Berlin

comic journal *Ulk*. The traveller is supposed to carry a water barrel, an oxygen reservoir and an extinguishing bomb, and to wear asbestos boots.

American Electro-chemical Society.—The fourth general meeting of this Society will be held at Niagara Falls, N.Y., on September 17th, 18th and 19th.

The following titles of papers are announced:—

"A New Type of Electrolytic Cell," by P. G. Salom.

"Manufacture of Ferro-Alloys in the Electric Furnace," by Dr. George P. Scholl.

"Electrolytic Copper Refining," by Dr. W. D. Bancroft.

"Electro-metallurgy of Gold," by Dr. W. H. Walker.

"Some Theoretical Considerations of Resistance Furnaces," by F. A. J. FitzGerald.

"On the Supposed Electrolysis of Water Vapour," by F. Austin Lidbury.

"Efficiency of the Nickel-Plating Tank," by Prof. O. W. Brown.

"Electrolysis of Sodium Hydroxide by Alternating Current," by Carl Hambuechen.

"A Practical Utilisation of the Passive State of Iron," by Prof. C. F. Burgess.

"The Present Status of the Theory of Electrolytic Dissociation," by Dr. E. F. Roeber.

"Berthelot's Law of Electro-chemical Action," by C. J. Reed.

Other papers are expected from Dr. J. W. Richards, David H. Browne, Dr. L. Kahlenberg, Prof. C. F. Burgess, A. H. Cowles, and others. One session of the meeting will be devoted to the discussion of the theory of electrolytic dissociation, which will be opened by Dr. W. D. Bancroft.

Arrangements have been made for members of the Faraday Society (London) to have a copy of the *Transactions* of the American Electro-chemical Society free in exchange for a like privilege from the Faraday Society.

Tramways and Light Railway Association.—The first meeting of the winter session is to be held in London early in October, when Mr. R. H. Scotter will deliver an address on "Fiscal Policy as Affecting Tramway and Light Railway Enterprise."

It is proposed to form a Tramway Club in London, and the secretary of the association is now sounding members as to their views.

The next Tramway Congress will be held early in September, 1904, in Vienna. The International Tramways and Light Railways Union has forwarded to the secretary a list of the questions to be submitted and discussed. The subjects are briefly:—(1) Depreciation; (2) Transfers; (3) Savings in Current Consumption; (4) Brakes; (5) Guide-wires; (6) Trailers; (7) Electric Traction on Light Railways; (8) Fall in Potential Thereon; (9) Permanent Way Therefor; (10) Comparative Legislation; (11) Accounts and Reports; (12) General Inspection; (13) Use of Automotors on Light Railways.

Single-phase Motors for Electric Traction.—Not only is the series single-phase motor being investigated by Mr. Lamme in America and Dr. Finzi; in Italy the Union Electric Co., of Berlin, are also busy in this direction, and have been carrying out experiments on the Prussian State Railway at Spindlersfelde, near Berlin. No details of the results are as yet available, but the mere fact shows the great interest which has been aroused in the matter amongst up-to-date electrical firms.

Electric Shock Fatality.—At Brymbo Steel Works last Saturday a labourer, aged 25, while helping with an electric crane, received a shock which killed him instantly. The electric motors were at the time being adjusted prior to testing.

Radium.—The New York *Electrical World* says that a company is being formed at Buffalo, N.Y., to extract radium from uranium ores which are being worked in Grand County, Utah. The Utah bed is of carnotite, a combination of uranium, vanadium, iron, copper and barium, and as later researches showed, radium and polonium. Prof. Becquerel's announcement of the radio-activity of uranium, followed as it was by the discovery of radium, started Mr. Lockwood thinking as to whether the uranium from Utah would not give up radium as well as the uranium extracted from the flinty pitchblende. The carnotite from Utah was much easier to work than the pitchblende. They enlisted the attention of the scientists in the eastern universities. Great aid was given them from the laboratories of Columbia and Princeton. "And at last a sample of radium-barium compound was produced which showed a potentiality of 365 on the delicate electroscope in Columbia University." A testing plant will soon be built at Buffalo with a capacity for the reduction of 2 tons of ore a day. Such a plant would turn out daily 100 lbs. of uranium oxide, worth $2 a lb.; 10,000 grammes of crude radium-barium compound of 10 units activity due to the radium, worth about two cents a gramme, and 100 lbs. of other metallic residues known to contain another radiant metal, polonium. The crude radium-barium product will be removed to a laboratory and there reduced to the ultimate radium.

Personal.—The *Sydney Daily Telegraph* reports that Mr. William Wilson, manager of the electric telegraph department, who has been on furlough for the past six months, has now retired on a pension, after 45 years' service. Mr. Wilson joined the department in 1858, about three months after its establishment, when he was appointed to Parramatta. He was appointed to the managership of the electric telegraph department in 1873.

Mr. W. C. C. Hawtayne announces that he has taken his managing engineer, Mr. G. A. Zeden, into partnership. The business will in future be carried on under the style of Hawtayne & Zeden.

Appointments Vacant.—Junior switchboard assistant at Lancaster; a borough electrical engineer is wanted for Morecambe at £150 (to £200); resident electrical engineer for Aston at £400; assistant lecturer in engineering for the Brighton Technical School (£150); engineer-in-charge for Darlington (£78).

World's Demand for Tool-making Machines.—"The *Deutsche Industrie Zeitung*, in its issue of July 17th, 1903, calls attention to a congress or convention of Germany's tool-machinery makers. Reports of those present went to show an increase of business in the empire; but the orders were not large enough nor the prices satisfactory. The orders from the Government were not nearly as large as desired. Complaint was made against the custom of the large iron mills of contracting for machinery only on condition that part payment be made in the iron or steel products of the mills. Another evil complained of is the custom of the iron or steel mills of making their own conditions when contracting, instead of following, as formerly, well-established customs. In the matter of contracts in which it is provided that the toolmakers take steel or iron from the mill, great abuses have crept in. The contract provides sometimes that fully 50 per cent. of the bill be paid in material. Inasmuch as the greater part of a tool-making machine's value lies in the labour expended on it and the most of the material is cast-iron, the demand of the mill to be allowed to pay for it in its products seems unfair and unjust. It is thought that little can now be done in individual or isolated cases, but that a combination of the machine builders might effect a reform. Reports made to the convention regarding foreign trade show a decline. In France everything was quiet, Italy offers little encouragement, Spain promises great things by and by, particularly for the marine. The United States, it was said, must be given up as hopeless, because of its own development of machine-making."—*Electrical World and Engineer.*

The Parsons Turbine Patent.—Our New York namesake has directed its readers' attention to the fact that the five years' extension period granted to the British patent of the Parsons steam turbine has now expired, throwing open this field of work to the public. The writer adds that the machine bids fair to become most important, but it can hardly be said that the inventor, even with the extension of his patent, has received the full reward of his labours.

Insulators.—Glass has one inherent disadvantage which is fatal to its employment as an insulator in our English climate. It is a very hygroscopic body, and condenses the moisture from the air very readily; it is for this reason altogether unsuitable. The atmosphere, in America, for instance, is comparatively dry as compared with that of this country. We can quite bear out the statements of Mr. Rooper and Mr. Harris (see our "Correspondence" columns), and Dr. Garrard has evidently something yet to learn on this subject.

THE CENTRAL STATION ENGINEER.

On Saturday last, August 29th, the first annual outing of the staff of the Stepney Borough Council Electricity Works took place, the rendezvous being Clacton-on-Sea. The weather was all that could be desired. The party travelled from Liverpool Street by special saloon, arriving at Clacton shortly after 10 a.m. An excellent repast was provided at the Osborne Hotel, the chairman for the occasion being Mr. W. Young, with Mr. A. J. Squire in the vice-chair. The toasts of the "King and Queen and Royal Family," "The Electrical Engineers (Mr. Arthur Wright and Mr. W. C. P. Tapper)," and "Success to the Undertaking," were proposed and drunk with great gusto, after which the chairman, in a few well-chosen words, commented on the success which had attended their first outing, and trusted that it was but the forerunner of many such enjoyable meetings, and that in future years, as the demand for electricity in Stepney increased, and the staff at the station grew in numbers, the outings would be even better attended and equally successful. He was sure they all regretted the unavoidable absence of their engineer, Mr. Tapper (who was away on a holiday). A vote of thanks to the chairman, the stewards, and the hon. treasurer (Mr. C. B. Davies) concluded the business. In the afternoon many of the party enjoyed a pleasant drive round the neighbourhood, visiting Great and Little Clacton, Wherley Woods, and pretty St. Osyth with its crumbling remains of a seventh century priory standing amidst beautiful gardens. The committee are indebted to Mr. Alderman Kearsey (chairman of the Electricity Committee) Mr. Alderman Osman and Mr. W. C. P. Tapper, for financial support in connection with the outing.

The employés of the electric lighting works at Reigate went for an outing to Brighton on August 25th. They were joined by a number of the other municipal departments. The cost was borne by the Mayor.

On Friday last interesting presentations were made to two Bradford Corporation officials who are leaving to take up other appointments. Mr. R. A. Chattock, who is leaving to take up the position of city electrical engineer at Birmingham, was presented by the Mayor with a gold watch, which had been subscribed for by the staff of the electricity works. Later in the day he was entertained at dinner at the Great Northern Victoria Hotel, and was presented, on behalf of a number of friends in the Corporation and out of it, with a set of spirit decanters in a case of a coromandel wood, inlaid with ivory. The same evening Mr. R. L. Horsfield, who has been appointed manager of the Walsall Corporation Tramways, was presented by his fellow officials with a handsome brass clock with side ornaments and a case of cutlery.

Mr. R. Pape, electrical engineer for the Borough of Morecambe since 1901, has obtained the appointment of electrical engineer to the Corporation of Port Elizabeth, South Africa. The commencing salary is £600, with first-class passage out, and rises to £750. It will be his duty to design an electric lighting and power scheme for Port Elizabeth, to superintend the construction of the station and installation, &c., and afterwards to act as the borough electrical engineer.

NEW COMPANIES REGISTERED.

Van Raden & Co., Ltd. (78,383).—This company was registered on August 21st, with a capital of £10,000 in £1 shares, to acquire the business of electrical engineers and motor ignition manufacturers, carried on by H. W. Van Raden, at Queen Victoria Road and Spon Street, Coventry, as "H. W. Van Raden & Co.," and to carry on the business of engineers, electricians, silk winders, spinners, washers and dyers, manufacturers of motor-cars and their fittings, parts and accessories, makers of motor ignition devices and electrical accumulators, metal founders, &c. The first subscribers (each with one share) are:—H. W. Van Raden, 2, Regent Street, Coventry, electrical engineer; Mrs. E. Van Raden, 2, Regent Street, Coventry; C. B. Robinson, The Elms, Coventry, engineer; V. W. Robinson, Lyndhurst, Kenilworth, solicitor; A. Sheffield, 34, Gordon Street, Coventry, clerk; W. H. Carson, 22, Radford Street, Coventry, clerk; and W. Shelley, 67, Canterbury Street, Coventry, clerk. No initial public issue. The number of directors is not to be less than three nor more than five; the first are H. W. Van Raden, C. B. Robinson and V. W. Robinson (all permanent); qualification 250 shares; remuneration as fixed by the company. Registered office, 142, Queen Victoria Road, Coventry.

Carlton Motor Co., Ltd. (78,354).—This company was registered on August 19th, with a capital of £800 in £1 shares, to manufacture and deal in motors, cycles, automobiles and locomotive or stationary engines of every description, and to carry on the business of electrical engineers, dealers in, and generators, storers, and suppliers of electrical and other power, machinists, fitters, millwrights, founders, wire drawers, &c. The first subscribers are:—A. Gower, 19, Elm Grove, Cricklewood, engineer, 1 share; A. H. Buffham, St. Elms, Vernon Road, Leytonstone, journalist, 99 shares; Miss G. Gower, Park Hill, Ampthill, Beds., 696 shares; Mrs. A. M. Buffham, St. Elms, Vernon Road, Leytonstone, 1 share; J. W. England, 427, Romford Road, Forest Gate, secretary, 1 share; W. J. Gower, 33, Queen's Gate Gardens, S.W., butler, 1 share; and H. A. Bullen, 430, Edgware Road, W., electrical engineer, 1 share. No initial public issue. Registered without articles of association.

Wave Power Co., Ltd. (78,426).—This company was registered on August 27th, with a capital of £12,000 in £1 shares, to adopt an agreement between the Morley Fletcher Wave Power System, Ltd., and the liquidator thereof of the first part, B. M. Fletcher of the second part, D. F. Basden of the third part, and this company of the fourth part, to acquire any letters patent, rights, privileges, licenses, concessions, monopolies and the like relating to any system for employing or utilising sea or other wave power, and to carry on the business of an electric light and power company in all its branches. The first subscribers (each with one share) are:—B. M. Fletcher, 7, Victoria Street, S.W., civil engineer; W. J. Ewing, 15, Houston Road, Forest Hill, S.E., secretary; E. Salmon, 8, Durham Road, Manor Park, engineer; L. E. Smith, 60, Grosvenor Street, W., barrister; L. W. Hawkins, 55, Mayford Road, S.W., chartered accountant; O. E. Stubbings, Elstead, Greenford Road, Sutton, Surrey, clerk; and G. F. Sagrot, 27, Milkwood Road, Herne Hill, S.E., clerk. No initial public issue. The number of directors is not to be less than three nor more than seven; the first are B. M. Fletcher, H. G. Smith, and L. E. Smith; qualification, 100 shares; remuneration as fixed by the company. Registered office: 3, St. Swithin's Lane, E.C.

Electrical Post Railway Co., Ltd.—This company was registered in Guernsey on August 15th, with a capital of £1,500,000 in £10 shares, with objects as indicated by the title. The first subscribers (each with one share) are:—A. J. Swan, 18, Ashbourne Grove, Chiswick Lane, Chiswick, clerk; W. J. Yeoman, 23, Muschamp Road, East Dulwich, S.E., clerk; E. T. Church, 2, Kepley Road, Clapham, S.W., clerk; A. J. W. Lawson, 43, Forest Drive West, Leytonstone, N.E., clerk; H. Spinks, 45, Roding Road, High Street, Homerton, N.E., clerk; J. W. Honess, 25, Pendle Hill, Streatham Park, S.W., clerk; and H. Ivan Robinson, 88, Dean Street, Oxford Street, London, W., clerk. The names of directors are not given.

Gell Telegraphic Appliances, Ltd. (78,405).—This company was registered on August 25th, with a capital of £30,000 in £1 shares, to adopt an agreement with J. Gell and others for the acquisition of certain patents and to turn to account the same or any other patents, inventions, licences, concessions, and the like. The first subscribers are:—G. Beetham, 11, Gledhow Gardens, S.W., gentleman, 500 shares; J. Gell, 8, Southwood Mansions, Highgate, N., electrical engineers, 500 shares; Sir K. Douglas, 64, Old Broad Street, E.C., Bart., 500 shares; Rev. R. M. Turnbull, Montague Street, Goulburn, N.S.W., 500 shares; L. M. Isitt, 4, Orlando Road, Clapham, S.W., lecturer, 300 shares; J. E. Martin, The Priory, Windermere, surgeon, 300 shares; and H. Calders, Stoke, Nelson, New Zealand, gentleman, 500 shares. No initial public issue. The first directors are J. Gell, G. Beetham, and Sir K. Douglass; qualification, £500; remuneration (except managing director), £550 per annum or such larger sum as may equal 10 per cent. of the net profits (not to exceed £10,000 in any year).

Metals Extraction Syndicate, Ltd. (78,415).—This company was registered on August 26th, with a capital of £5,500 in £1 shares, to adopt an agreement with H. R. Cassel for the acquisition of the patent rights for an invention in relation to an electrolytical process for the extraction of gold and precious metals from refractory ore, and generally to carry on the business of assayers, smelters, electricians, metallurgists, &c. The first subscribers (each with one share) are:—A. Govey, 12, Manor Road, Stoke Newington, N., clerk; F. C. Taplin, 60, Fenchurch Street, E.C., accountant; A. E. F. Court, 20, Playfield Crescent, Melbourne Grove, E. Dulwich, stenographer: F. H. F. Jones, 90, Avondale Square, S.E., stenographer; A. M. Brown, "Holmwood," Grove Vale, E. Dulwich, S.E., clerk; T. G. Adams, 49, Ravenswood Road, Balham, clerk; and A. F. Jones, 42, Tremadoc Road, Clapham, S.W., clerk. No initial public issue. The number of directors is not to be less than two nor more than four; the subscribers are to appoint the first; qualification, one share; remuneration as fixed by the company.

Electrical Indicator Syndicate, Ltd. (78,431).—This company was registered on August 28th, with a capital of £5,000 in £1 shares, to adopt an agreement between C. Baxter and W. H. Callow, to acquire and turn to account patents, rights, *brevets d'invention*, licences, concessions and the like, and to carry on a business not particularly described except in the title. The first subscribers (each with one share) are:—W. H. Callow, 13, Highbury Hill, N., gentleman; C. Baxter, Dock House, Billiter Street, E.C., engineer; T. K. Warhurst, 2, Russell Road, Crouch End, N., clerk; F. W. Callow, 13, Highbury Hill, N., book-keeper; C. J. Bates, 39, Sainsbury Road, Upper Norwood, S.E., plumber; and Mrs. E. E. Warhurst, 2, Russell Road, Crouch End, N. No initial public issue. The first directors are C. Baxter, W. H. Callow (chairman), and T. K. Warhurst; qualification, 100 shares. Registered Office: Dock House, Billiter Avenue, Billiter Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Lisbon Electric Tramways (62,983).—This company's annual return was filed on June 16th, when 500,000 ordinary and 425,553 preference shares had been taken up out of a nominal capital of £1,000,000 in 500,000 ordinary and 500,000 preference shares of £1 each. £925,553 is considered as paid. Debentures: £500,000.

Mexico Electric Tramways, Ltd. (56,932).—This company's annual return was filed on June 16th, when the entire capital of £1,000,000 in 500,000 ordinary and 500,000 preference shares of £1 each had been taken up. £500,000 has been paid on the preference, and £100,000 is considered as paid on the ordinary shares. Debentures: £400,000.

Callender's Cable and Construction Co., Ltd. (48,915).—This company's annual return was filed on June 30th, when 35,000 ordinary and 40,000 preference shares had been taken up out of a nominal capital of £500,000 in 60,000 ordinary and 40,000 preference shares of £5 each. £5 per share has been called up on 55,000 shares, resulting in the receipt of £275,000. £100,000 is considered as paid on 20,000 shares. Mortgages and charges: £200,000.

Harrington Electric Light Co., Ltd. (44,135).—This company's annual return was filed on June 10th, when 3,900 shares had been taken up out of a nominal capital of £5,000 in £1 shares. £1 per share has been called up on 3,000, and 10s. per share on 900, resulting in the receipt of £3,450. No mortgages or charges.

Electric & General Investment Co., Ltd. (31,506).—This company's annual return was filed on July 27th, when the entire capital of £200,000 in 20,000 ordinary, 100 founders', and 19,900 preference shares of £5 each had been taken up. £1 per share has been called up on the ordinary and £5 per share on the founders' and preference shares, resulting in the receipt of £120,000. No mortgages or charges.

United River Plate Telephone Co., Ltd. (23,654).—This company's annual return was filed on July 28th, when 58,000 ordinary and 40,000 preference shares had been taken up out of a nominal capital of £500,000 in 60,000 ordinary and 40,000 preference shares of £5 each. £5 per share has been called up on 42,000 ordinary and 40,000 preference shares, resulting in the receipt of £410,000. £80,000 is considered as paid on 16,000 ordinary shares. Mortgages and charges: £179,947.

Electrical Power Storage Co., Ltd. (30,313).—This company's annual return was filed on August 6th, when 66 founders' and 18,592 ordinary shares had been taken up out of a nominal capital of £100,500 in 100 founders' and 20,000 ordinary shares of £5 each. £5 per share has been called up on 66 founders' and £4 per share on 3,132 ordinary shares. £13,332 5s. 1d. has been received, including £474 5s. 1d. paid on four founders' and 495 ordinary shares forfeited. £77,300 is considered as paid on 15,460 ordinary shares. Mortgages and charges: £28,400.

New Century Arc Light Co., Ltd. (67,849).—This company's annual return was filed on July 9th, when 5,000 preference and 14,306 shares had been taken up out of a nominal capital of £30,000 in 5,000 preference and 25,000 ordinary shares of £1 each. £1 per share has been called up on 2,506, resulting in the receipt of £2,506. 16,800 shares are considered as fully paid. Mortgages and charges: £5,500.

Northampton Electric Light and Power Co., Ltd. (28,640).—Issue on August 5th of a debenture for £50, part of series created June 3rd, 1896, to secure not more than two-thirds of the paid-up capital for the time being, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £28,200.

Guildford Electricity Supply Co., Ltd. (36,725).—Issue on July 17th of £1,000 debentures, part of series created November 19th, 1900, to secure £15,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £14,100 (*sic*).

British Electric Transformer Co., Ltd. (76,351).—This company's annual return was filed on June 11th, when 30,390 preference and 69,114 ordinary shares had been taken up out of a nominal capital of £125,000 in 50,000 preference and 75,000 ordinary shares of £1 each. 7s. per share has been called up on 30,390 preference and 9,114 ordinary shares, resulting in the receipt of £17,080 9s., and leaving £356 19s. in arrears, 60,000 ordinary shares are considered as fully paid. No mortgages or charges. 100 preference shares (7s. called up) were allotted on June 8th. The name was changed to the British Electric Transformer Co., Ltd., on July 16th.

Electrical Supplies, Rubber and Ebonite Co., Ltd., Sheffield (69,894).—£1,500 debentures, created and dated June 23rd, 1903, charged on the company's undertaking and property, present and future, were registered (by permission of the Court) on August 6th. No trustees.

J. G. White & Co., Ltd. (66,568).—This company's annual return was filed on July 13th, when the entire capital of £150,000 in 10,000 preference shares of £10 each and 50,000 ordinary shares of £1 each had been taken up. 50,000 ordinary shares are considered as fully paid, and £10 per share has been called up and paid on the preference. Mortgages and charges: *nil*.

Midland Electric Corporation for Power Distribution, Ltd. (53,071).—A trust deed dated July 29th, 1903, to secure £250,000 4½ per cent. debentures, created by resolution of April 27th, 1903, has been registered. Property charged: the company's freehold and leasehold properties, present and future, and its undertaking and other assets for the time being, including uncalled capital. Trustees: J. S. H. Banner, 24, North John Street, Liverpool; and F. F. Begg, Bartholomew House, E.C.

Electric Timber Seasoning and Preservation Co., Ltd. (61,428).—A charge to secure an unspecified amount, but stamped to cover £800, charged on the company's undertaking and property, present and future, has been registered. Holder: H. B. Weaver, 11, Stone Buildings, Lincoln's Inn, W.C.

Thomas Parker, Ltd. (40,973).—This company's annual return was filed on July 31st, when the entire capital of £75,000 in £10 shares had been taken up. £57,500 has been paid, and £17,500 is considered as paid. Mortgages and charges: £60,000.

Tyer & Co., Ltd. (56,760).—This company's annual return was filed on July 18th, when 22,007 shares had been taken up out of a nominal capital of £25,000 in £1 shares. £2,000 has been paid, and £20,000 is considered as paid. No calls on seven shares. Mortgages and charges: *nil*.

Bryan, Donkin & Clench, Ltd., electrical engineers, Chesterfield (65,329).—An instrument of charge under the Land Transfer Acts, 1875 and 1897, dated August 1st, 1903, supplemental to trust deed of even date, to secure £120,000 debenture stock created by resolutions of May 28th and July 31st, 1903, has been registered. Property charged: the company's freehold and leasehold land at Bermondsey. Trustees:—E. A. Smith, Longhills, Branston; and A. B. L. Melville, Branston Hall, Branston.

United Electric Light and Power Supply Co., Ltd. (72,034).—Issue on August 11th, of £625 debentures, part of series created March 17th, 1903, to secure £3,000, charged on the company's undertaking and property, present and future, including all its buildings, machinery and other property at Guimarães, Portugal, and its uncalled capital. No trustees. Previously issued of same series: £925.

Crompton & Co., Ltd. (27,200).—This company's annual return was filed on August 28th, when 85,000 shares had been taken up out of a nominal capital of £300,000 in 100,000 shares of £3 each. £3 per share has been called up on 83,000 shares, resulting in the receipt of £249,000. £6,000 is considered as paid on 2,000 shares. Mortgages and charges: £100,000.

Electric Construction Co., Ltd. (39,296).—This company's annual return was filed on August 18th, when 31,390 preference and 112,100 ordinary shares had been taken up out of a nominal capital of £400,000 in 50,000 preference and 150,000 ordinary shares of £2 each. £2 has been called up on 18,245 preference and 2,100 ordinary shares, resulting in the receipt of £40,690. £246,290 is considered as paid on 13,145 preference and 110,000 ordinary shares. Mortgages and charges: £250,000.

Sherard Cowper-Coles & Co., Ltd., electricians, London (67,136).—Issue on August 14th of £225 debentures, part of series created by resolutions of December 3rd, 1901, and February 7th, 1902, to secure £6,500, charged on the company's real and personal property, present and future, except uncalled capital. No trustees. Previously issued of same series: £5,350.

ELECTRICITY SUPPLY ACCOUNTS.

Kingston-upon-Thames Municipal Electric Supply.

The lot of the Kingston electrical department has not, up to the present, been by any means a happy one; but the results shown by the last accounts indicate that an improvement in the right quarter (*i.e.*, in the generating costs) has been achieved, which, if maintained, will doubtless enable Mr. Edgcombe, the borough electrical engineer, to place his department on a satisfactory basis. In the works costs, the fuel item calls for most comment, showing a decrease of nearly 1d. per unit, and £1,040 in the total, notwithstanding that 47,000 units more have been sold. The improved load factor, and the fact that the gross profit has reached 4·4 per cent. on the capital outlay as compared with 2·4 per cent.—in the previous year—are also hopeful signs. During the year some five miles of arc cable and 35 arc lamps have been added to the street lighting of the borough. The prices charged are, 6d. and 3d. on the maximum demand system for private lighting, and 3d. and 2d. per unit for power.

The results of the past few years' working will be gathered from the following figures:—

Year.	Av. revenue per unit sold.	Works cost per unit sold.	Units sold.	Equiv. 8-c.p. lamps connected.
1898 (15 months)	4·85d.	3·60d.	232,370	11,856
1900	4·94d.	3·15d.	364,000	16,130
1901	5·09d.	4·96d.	308,860	18,899
1902	5·11d.	4·04d.	346,332	22,885
1903	5·06d.	3·01d.	392,962	25,767

General Statement.

Year ending March 31st—	1902.	1903.	Inc.
Total capital expended ...	£71,548	£82,784	£11,236
Units supplied—			
Private consumers	266,110	312,706	46,596
Public lamps	80,222	80,256	34
Total	346,332	392,962	46,630
Equivalent number of 8-c.p. lamps connected	22,885	25,767	2,882
Number of public lamps ...	41	76 arcs	35
Maximum load in kw.	360	362	2
Revenue Account. Gross revenue ...	£7,379	£8,341	£962
" expenditure	£5,836	£4,930	— £906
" profit ...	£1,543	£3,411	£2,868
Average price obtained per unit private lighting	5·80d.	5·40d.	— ·40d.
Average price obtained per unit public lighting	2·59d.	2·62d.	·03d.

Revenue Statement.

	1902. Gross.	1902. Per unit.	1903. Gross.	1903. Per unit.	Inc.
Sale of energy	£7,187	5·00d.	£8,122	4·98d.	—·02d.
Meter rents, &c. ...	192	·11d.	129	·08d.	—·03d.
Gross revenue ...	£7,379	5·11d.	£8,341	5·06d.	—·05d.

Cost of Production.

	1902. Gross.	1902. Per unit.	1903. Gross.	1903. Per unit.	Inc.
Coal and other fuel	£3,556	2·46d.	£2,516	1·54d.	—·92d.
Oil, waste, water and engine-room stores	295	·20d.	245	·15d.	—·05d.
Wages incurred in generation and distribution	640	·45d.	693	·42d.	—·03d.
Repairs and manufacture of machinery, buildings and plant	538	·23d.	844	·21d.	—·02d.
Works and distribution costs	£4,829	3·34d.	£3,798	2·32d.	—1·02d.
Attendance and repairs, public lamps	224	·16d.	227	14d.	—·02d.
Rent, rates and taxes	127	·09d.	98	·06d.	—·03d.
Management expenses, salaries of engineer and clerical staff ..	442	·31d.	460	·28d.	—·03d.
General establishment charges, stationery, printing, law and insurance	196	·13d.	194	·12d.	—·01d.
Sundry charges	18	·01d.	153	·09d.	·08d.
Total works cost	£5,836	4·04d.	£4,930	3·01d.	—1·03d.

Profit Statement.

	1902.	1903.
To interest on loans	£1,744	£2,022
Sinking fund	2,093	2,325
Deficit on year	—2,294	—936
Gross profit	£1,543	£3,411

The improved financial conditions of the last 12 months will be gathered from the profit statement. After paying interest and sinking fund, the deficit amounts to £936, as compared with £2,294 in the previous year.

CITY NOTES.

Mather & Platt, Ltd.

The annual meeting of Mather & Platt, Ltd., was held in Manchester on August 27th.

Sir William Mather, M.P., replying to a shareholder who desired to raise a discussion upon free trade *versus* protection in the metal industries, said that he would not take up the time of the meeting in endeavouring to expose the extreme fallacies and absurdities which surrounded the fiscal reform proposals. He was very hopeful, says the *Financial Times*, as to the future of the British iron, electrical and engineering industries, provided that the workmen and their leaders and the young men of all classes would equip themselves as the young of America, and, in a lesser degree, those of Germany, had done. If this were secured, the future of the iron and all other British industries would be bright. In regard to the company's results for the past year, he said they were satisfactory in view of the condition of trade generally, and it was also satisfactory to find that the large foreign connections which the company had cultivated for many years past, especially in Europe, had stood them in good stead in the 12 months. Their foreign customers had responded most satisfactorily.

Stock Exchange Notices.—The Committee has appointed special settling days as under:—Thursday, September 10th. Marconi's Wireless Telegraph Co., Ltd.—Further issue of 39,028 shares of £1 each, fully paid, Nos. 157,084 to 196,111. And ordered the undermentioned securities to be quoted in the Official List:—British Electric Traction Co., Ltd—Further issue of 37,500 6 per cent. cumulative preference shares of £10 each, fully paid, Nos. 318,938 to 356,437.

Bank Rate Altered.—Yesterday (Thursday) the bank rate was increased from 3 to 4 per cent.

STOCKS AND SHARES.

Wednesday Evening.

While the tone of the investment markets continues very steady, there is not much doing in any of them. The commencement of September is generally hailed with a certain amount of relief as likely to bring the listlessness of summer to an end, but the latter remains very much to the fore, and the hot weather seems to prolong the days of recess. Besides, the Stock Exchange is closed on Saturday, and there is a promise of other holidays later on.

Except for a few changes consequent upon prices being marked *ex* dividend, the electrical sections are singularly free from fluctuation. The supply shares display a few advances. County of London Ordinary and Preference have both recovered their dividends, and so have London Electric Preference, the deductions being 4s., 6s. and 3s. per share respectively. Edmundson's Preference have come into demand, and the quotation is a little better, while Metropolitan Ordinary are up 10s., thus more than making up the 8s. dividend which the shares were marked *ex* on August 13th. To diverge into provincials, Oxfords are 5 and Hove 8, Folkestones being 6¼, Bournemouth 13, and the Preference 10½. The last named receive 4½ per cent. dividend, and the second Preference, carrying a 6 per cent. cumulative dividend, look reasonably cheap at 10½, although the fact that there are but 7,500 of the shares in existence naturally makes the market a very restricted one.

British Electric Traction new Preference shares have at last received notice of a special settlement, after several months of waiting. There was some technical objection raised by the committee of the Stock Exchange in regard to the number of shares publicly allotted, but this difficulty was eventually overcome, and, as we say, the shares are at length admitted to special settlement. There is no change in the price of the Preference, but the Ordinary are a good market and exhibit a 15s. rise. London United Tramways Preference have been more active this week, and still change hands in the neighbourhood of 12, the Debenture stock continuing at 106. All kinds of rumours circulate in the West of London with regard to the intention of the company and its efforts to get across Hammersmith Bridge. One report goes so far as to say that the London United mean to build a special bridge of their own across the river if they can get the necessary permission!

Provincial tramways have hardened to 5, Anglo-Argentines are dealt in daily round about 4¾, Potteries are 9½, the Preference at the same price being 10s. easier on the week, while Barcelona keep at 8, and Belgrano Ordinary at 2½. It is somewhat surprising that the buoyancy induced in other markets by the capital Argentine Budget should not have made itself felt in the Belgrano issue; the "A" and "B" issues are 5¼ and 5 respectively.

As it was supposed would be the case, the fears excited by the recent accident on the Paris "Metro" have considerably calmed down by this time. None of the electrical railway stocks have fallen this week; Central London Ordinary is a shade harder actually, though not quotably, and one cannot buy the stock below par, while 100½ has been paid for it several times during the last day or two. The Preferred has advanced a point. City and South London keeps at 60 middle, at which price it is easier to sell stock than to buy it. Metropolitan Consolidated is receiving a little attention at about 84½, but Districts, 50 points lower, are entirely neglected. British Columbia Electric Tramways Deferred at 76½ is 1 per cent. firmer.

Several alterations vary the usual monotony of the manufacturing list. Of these the chief is a rise of four points in British Aluminium 5 per cent. Debenture stock, the market being in short supply, and several buyers coming along. Crompton Debenture shed 1 per cent., and so did Electric Construction Debenture. Both the Henley shares are *ex* dividend, and although there has been no change in the price of the Preference, the Ordinary are nominally down 4s. on balance.

Almost the only variation amongst telegraph stocks is a ½ fall in Cuba Preference; West India and Panama First Preference are also ¼ easier, following the decline of the Ordinary last week, when fears of what might have happened through the Jamaica cyclone were responsible for a small relapse. None of the Anglo-American varieties have moved, despite the yacht races, and the Trust shares are equally immobile. London, Platino-Brazilian Debentures fell 3 on the deduction of the same amount for interest, and Western Telegraph Debenture has risen a point. Telephone issues are on the same plane as those of the Telegraph Companies, and all that can be said of them is that there is but little doing. What attention they do command is wholly confined to the Deferred and the Preferred stocks.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Aug. 26th.	Closing Quotations Sept. 2nd.	Business done week ended Sept. 2nd, 1903. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	98 —102	98 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2⅛— 3⅛	2⅛— 3⅛	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	70 — 80	..	..
788,840	Anglo-American Telegraph	Stock	3½%	6is.	60/6	47 — 50	47 — 50	47⅛	..
8,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	90 — 92	90 — 92	91¼	90½
8,105,580	Do. do. do. Deferred	Stock	5s. %	2s.	1/-	8 — 8⅛	8 — 8⅛	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	5 %	6 %	4⅜— 5⅛	4⅜— 5⅛	..	..
18,333,300$	Commercial Cable	$100	8 %	8 %	8 %	150 —160	150 —160	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	93 — 96	93 — 96	93⅜	93¼
16,000	Cuba Telegraph	10	4½%	4 %	6½%	7 — 8	7 — 8	..	..
6,000	Do. 10 % Pref.	10	..	..	..	17 — 18	16½— 17½	..	..
12,981	Direct Spanish Telegraph	5	4 %	4 %	4 %	2½— 3⅛	2½— 3⅛	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	97 —101 %	97 —101 %	..	..
60,710£	Direct United States Cable	20	3½%	3½%	3½%	10 — 10½	10 — 10½	10⅜	10⅛
87,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	124 —129	124 —129	126⅜	125
1,955,565	Do. 3½ % Pref. Stock	100	..	..	..	90 — 93	90 — 93	93	91½
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —108	105 —108	107	..
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	12 — 12½	12 — 12½	12½	12
820,000£	Do. 4 % Deb. Stock	Stock	..	..	..	104 —107	104 —107	..	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	98 —101	98 —101	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	100 —103	100 —103 %	..	..
180,227	Globe Telegraph and Trust	10	5½%	5½%	..	9 — 9¼	9 — 9¼	9⅜	..
180,042	Do. do. 6 % Pref.	10	..	..	..	12⅝— 13¼	12⅝— 13¼	13⅛	12⅞
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	15 %	12½%	22 — 23	22 — 23	..	..
62,500£	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	10%	36 — 39	36 — 39	39	..
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	100 —104	97 —101 xd	..	..
1,983,333	National Telephone, Pref. Stock	100	5 %	5 %	6 %	100 —102	100 —102	101½	100¼
1,966,667	Do. do. Def. Stock	100	..	..	4½%	78 — 80	78 — 80	79	78¼
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	13⅜	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5 — 5¼	5 — 5¼	5⅛	..
000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	96 — 98	96 — 98	..	..
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	101 —103	101 —103	..	..
171,504	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6 %	⅞— 1⅛	⅞— 1⅛	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,889	Reuter's	8	5 %	5 %	..	6½— 7½	6½— 7½	..	..
3,803	Submarine Cables Trust	Cert.	..	..	..	116 —121	116 —121	..	..
58,000	United River Plate Telephone	5	7 %	7 %	7 %	5½— 6	5½— 6	5⅝	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4⅜— 5¼	4⅜— 5¼	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	104 —107	104 —107	..	..
15,600	West African Telegraph, Shares	10	..	..	2 %	5 — 6	5 — 6	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	..	..	..	95 — 98	95 — 98	..	..
267,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	..	12 — 12½	12 — 12½	12⅛	12⅛
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	100 —103	100 —103	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	97 —100	98 —101	99½	98
88,321	West India and Panama Telegraph	10	2%	..	..	⅞— 1	⅞— 1	..	..
34,568	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6¼— 7	6¼— 6⅞	6½	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	3¾— 4¼	3¾— 4⅜	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	98 —101	98 —101	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	3 — 4	3 — 4	..	..
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	79 — 85	83 — 87	85½	85
100,000	British Electric Traction	10	9 %	9 %	8 %	11¾— 12¼	12⅜— 13	12⅝	12.7/8
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	11¾— 12¼	11⅞— 12½	12.1/8	11⅞
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	122 —125	122 —125	..	..
100,000	British Insulated and Helsby Cables	5	15 %	10 %	10 %	6⅞— 7⅛	6⅞— 7⅛	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5¼— 5⅜	5¼— 5⅜	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	102 —106	102 —106 *	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	8 %	Nil	..	⅜— 11/16	⅜— 11/16	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	6 %	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	5 %	Nil	Nil	¾— 1⅛	¾— 1⅛	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	3 %	6 %	1 — 1⅛	1 — 1⅛	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	99 —102	97 —100 xd	99	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	85 — 90	85 — 90	..	..
35,000	Callender's Cable Construction shares	5	15 %	20 %	15 %	11½— 12½	11½— 12½	12⅜	11⅞
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5¼— 5⅝	5¼— 5⅝	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	106 —110	106 —110	109	108
1,860,014	Central London Railway, Ord. Stock	Stock	..	4 %	4 %	98 —101	98 —101	100½	99½
494,098	Do. do. 4 % Pref. Stock	Stock	..	4 %	4 %	99 —102	100 —103	102	..
494,998	Do. do. Def. do.	Stock	..	4 %	4 %	101 —104	101 —104	..	..
1,330,000	City and South London Railway	Stock	1½%	2 %	3½%	59 — 61	59 — 61	60	59
85,000	Crompton & Co., Nos. 1 to 85,000	3	8 %	7½%	5 %	2 — 2½	2 — 2½	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	101 —105	101 —104	101⅛	101⅛
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	2½%	Nil	..	0 — ¼	0 — ¼	..	..
17,139	Do. do. "A" shares, 01—017,139	5	2½%	Nil	..	1⅛— 2⅜	1⅛— 2⅜	..	..
344,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	71 — 75	71 — 75	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	75 — 80	75 — 80	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1⅜— 1⅝	1⅜— 1⅝	..	..
31,890	Do. do. 7 % Cum. Pref., 1 to 31,890	2	..	..	..	2⅜— 3	2⅜— 3	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	99 —102	98 —101	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	9⅛— 10	9⅛— 10	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	99 —102	99 —102	..	..
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	20 %	14 — 15	13⅛— 14⅛ xd	..	..
35,000	Do. do. 4½ % Pref.	5	4½%	..	..	5 — 5⅛	5 — 5⅛ xd	..	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	108 —112	107 —111 xd	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	10 %	18½— 19½	18½— 19½	..	..
800,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	8½%	1½%	1½%	5¼— 5⅝	5¼— 5⅜	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10¾— 11	10¾— 10¾xd	..	..
37,350	Telegraph Construction and Maintenance	12	17½%	20 %	20 %	34 — 37	34 — 37	36	35½
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	100 —103	100 —103	..	..
640,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3 %	3⅛%	95— 98	95 — 98	..	..

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

National Electric Free Wiring, ⅛—¼.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 14¼—14⅝.
Do. do. Pref. (£10 pd.), 10—10⅛.

Ban rate of discount 3 per cent. (June 18th, 1903).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Aug. 26th.	Closing Quotations Sept. 2nd.	Business done week ended Sept. 2nd, 1903. Highest.	Lowest.
100,000	Blackheath and Greenwich Dist. Electric Light, Ord...	‡	..	..	..	⅜— ⅞	⅜— ⅞	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs. ..	1	..	..	..	118 —121	118 —121	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	100	..	..	..	118 —121	118 —121	..	..
20,000	Do. do. 7 % Cum. Pref. ..	5	6 %	8 %	8 %	10½— 11	10½— 11	10 1/16	10 1/16
50,000	Charing Cross and Strand Electricity Supply	5	..	..	..	10¼— 10¾	10½— 10¾	..	..
70,000	Do. do. do. 4½% Cum. Pref. ..	5	9 %	10 %	10 %	9 — 9¼	9 — 9¼	9⅛	9 1/16
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	5¼— 6	5½— 6	5 1/16	..
250,000	Do. do. 4 % Deb. Stock Red.	5	..	..	..	4¼— 5	4¼— 5	4 1/16	..
44,436	*Chelsea Electricity Supply, Ord.	100	..	..	..	104 —106	104 —106	105	..
150,000	Do. do. % Deb. Stock Red.	5	5½%	4 %	4¼%	5¾— 6¼	5¾— 6¼	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595	Stock	..	..	..	108 —111	108 —111	..	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	0 %	5 %	5 %	10¾— 11¼	10¾— 11¼	..	..
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	10	6 %	..	..	13 — 14	13 — 14	..	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	..	..	..	..	122 —127	122 —127	..	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000..	100	..	..	..	102 —105	102 —105	..	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000..	10	4 %	4 %	4 %	8 — 9	8 — 9 xd	..	..
400,000£	Do. do. 4½% Deb. Stock, Prov. Certs. (all paid) Red ..	10	..	..	..	11½— 12½	11½— 12½xd	..	..
50,000	Edmundson's Electric Corporation, Ord. Shares	..	..	..	..	109 —112	109 —112	..	..
80,000	Do. do. 6 % Cum. Pref.	5	7 %	7 %	7 %	6½— 7	6½— 7	6 1/16	6⅜
140,000	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	6 — 6½	6½— 6¾	6 1/16	6⅜
21,000	Kensington and Knightsbridge Electric, Ord.	100	..	..	..	107 —110	107 —110	107	..
90,000	Do. do. do. 4 % Debenture Stock ..	5	12 %	10 %	10 %	10½— 11½	10½— 11½	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	Stock	..	..	..	108 —106	103 —106	..	..
49,840	Do. do. do. 6 % Pref.	3	..	..	..	2 — 2½	2 — 2½	..	..
250,000£	Do. do. do. 4 % 1st Mort. Deb. Stock Red	5	..	..	..	5½— 6	5½— 6 xd	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	Stock	..	..	..	100 —102	100 —102	..	..
220,000£	Do. do. 4½% 1st Mort. Deb. Stock	10	6 %	6½%	7½%	17 — 18	17½— 18½	18	..
250,000£	Do. do. 3½% Mort. Deb. Stock Red	..	..	..	..	108 —112	108 —112	..	..
10,852	Notting Hill Electric Lighting	Stock	..	..	..	97 —100	97 —100	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	10	7 %	6 %	6 %	13 — 14	13 — 14	..	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	14½%	14½%	14½%	15½— 16½	15½— 16½	15⅝	15½
150,000£	Do. do. do. 3½% Deb. Stock Red ..	5	..	..	..	8 — 9	8 — 9	8½	..
12,000	Smithfield Markets Electric Supply, Ord.	100	..	..	..	98 —101	98 —101	..	..
65,000	South London Electricity Supply, Ord.	5	..	..	2½%	3½— 3¾	3½— 3¾	..	..
30,000	Urban Electric Supply, Ord.	5	..	..	1¾%	3¾— 4¼	3¾— 4¼	..	..
30,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5 — 5½	5 — 5½	5⅜	..
110,000	Westminster Electric Supply, Ord.	5	10½%	10½%	12 %	5 — 5¾	5 — 5¾	..	..
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	13 — 14	13 — 14	13 1/16	13⅛
		5	..	..	..	6 — 6½	6 — 6½	..	..

*Subject to Founders Shares. ‡Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, September 2nd.

	CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/-	..
a	,, Nitric	per cwt.	22/-	..
a	,, Oxalic	per cwt.	32/-	..
a	,, Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a	,, ,, ...	per ton	£30	..
a	Bleaching powder	per ton	£4 10	..
a	Bisulphide of Carbon	per ton	£15	..
a	Borax	per ton	£13	..
a	Benzole (90 %)	per gal.	7/-	..
a	,, (50/90 %)	per gal.	5/6	..
a	Copper Sulphate	per ton	£20	..
a	Lead, Nitrate	per ton	£24	..
a	,, White Sugar	per ton	£31	..
a	,, Peroxide	per ton	£27 10	..
a	Methylated Spirit	per gal.	2/6	..
a	Naphtha, Solvent (90% at 160° C).	per gal.	5/6	..
a	Potash, Bichromate, in casks ..	per lb.	8d.	..
a	,, Caustic (75/80%).. ..	per ton	£24	..
a	,, Bisulphate	per ton	£35	..
a	Shellac	per cwt.	157/-	..
a	Sulphate of Magnesia	per ton	£4 10	..
a	Sulphur, Sublimed Flowers ..	per ton	£6 10	50/- dec.
a	,, Recovered	per ton	£5 10	..
a	,, Lump	per ton	£5	..
a	Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a	,, Crystals	per ton	£8	..
a	,, Bichromate, casks.. ..	per lb.	2¼d.	..
	METALS, &c.			
b	Aluminium Ingots, in ton lots ..	per ton	£130	..
b	,, Wire, in ton lots ..	per ton	£168	..
b	,, Sheet, in ton lots ..	per ton	£166	..
p	Babbitt's metal ingots	per ton	£43 to £145	..
c	Brass (rolled metal 9" to 12") basis	per lb.	7d.	..
c	,, Tube (brazed)	per lb.	8¾d	..
c	,, ,, (solid drawn).. ..	per lb.	7¾d.	..
c	,, Wire, basis..	per lb.	7¼d.	..
c	Copper Tubes (brazed)	per lb.	9¼d.	..
c	,, ,, (solid drawn) ..	per lb.	9¾d.	..
g	Copper Bars (best selected ..	per ton	£75	£4 inc.

	METALS, &c. (*continued*).		Latest Price.	Week's Inc. or Dec.
g	Copper Sheet	per ton	£75	£4 inc.
g	,, Rod	per ton	£75	£4 inc.
e	,, (Electrolytic) Bars ..	per ton	£66	..
e	,, ,, Sheets ..	per ton	£76	..
e	,, ,, Rod ..	per ton	£68	..
e	,, ,, H.C. Wire	per lb.	8d.	..
f	Ebonite Rod	per lb.	3/8	..
f	,, Sheet	per lb.	3/-	..
n	German Silver Wire	per lb.	1/6	..
h	Gutta-percha fine	per lb.	3/-	..
h	India-rubber, Para fine	per lb.	4/2 to 4/4	inc.
i	Iron, Charcoal Sheets	per ton	£18	..
i	,, Pig (Cleveland warrants)	per ton	46/10½	½d. inc.
i	,, Forgings, according to size	per ton	From £11	..
i	,, Scrap, heavy	per ton	47/6 to 50/-	..
i	,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g	Lead, English Ingot	per ton	£11 5 to £11 7 6	2/6 dec.
g	,, ,, Sheet	per ton	£13	..
m	Manganin Wire No. 28	per lb.	8/-	..
g	Mercury	per bot.	£8 10	..
d	Mica (in original cases) small ..	per lb.	4d. to 1/6	..
d	,, ,, ,, medium	per lb.	2/6 to 3/9	..
d	,, ,, ,, large ..	per lb.	4/- to 7/9	..
p	Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p	,, rolled bars & rods	per lb.	1/1 to 1/4	..
p	,, ,, strip & sheet	per lb.	From 1/2	..
o	Platinum	per oz.	£4	..
p	Silicium Bronze Wire	per lb.	10d. to 1/-	..
i	Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i	,, ,, in bars		£15 to £40	..
g	Tin, Block	per ton	£124 to £125	70/- dec.
g	,, Foil	per lb.	1/6	..
n	Wire, Nos. 1 to 16	per lb.	1/7	..
p	White Anti-friction Metals— "White Ant" brand ..	per ton	£42 to £65	..
j	Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j	,, 6 lea. Flax	per lb.	5⅝d.	..
j	,, 8 ply 10 lbs. Russian ..	per lb.	4 15/16d.	..
j	,, 10 lbs. Russian, single ..	per lb.	4¼d.	..
j	,, 180 lbs. Jute rove	per ton	£11	..
k	Zinc, Sh't (Vieille Montagne bnd.)	per ton	£24 5	10/- inc.

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

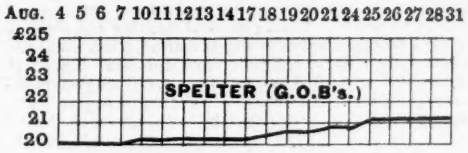
ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RECEIPTS.

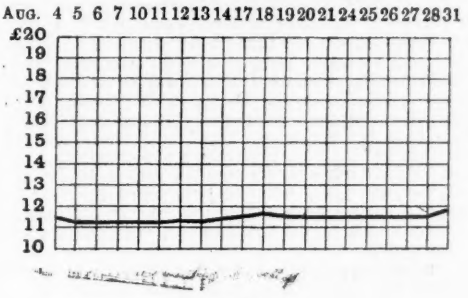
	Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open.	*
	Aberdeen	Aug. 29	1,470	+178	17,444	+ 2,214	10	—
	Birmingham	,, 29	5,089	+ 42	176,683	+ 8,182	—	—
	Bournemouth	,, 26	1,440	—	—	—	10½	—
	Blackburn	June 26	909	—286	11,668	+ 674	12½	+1½
	Blackpool	Aug. 27	1,997	— 71	25,744	+ 894	8½	—
	Blackpool and Fleetwood	,, 29	1,486	—127	12,718	+ 593	7½	—
	Bolton	,, 30	1,734	+ 72	41,860	+ 5,654	25	—
	Bradford	,, 23	4,267	+579	81,276	+13,000	41	+4
	Brighton	,, 30	1,092	— 3	35,078	—	6½	—
	Bristol	,, 28	5,029	— 32	—	—	28	—
	Burnley	,, 29	870	+112	—	—	7½	—
B.E.T. Co.	Barnsley District ..	,, 21	212	—	6,001	—	4½	—
B.E.T. Co.	Devonport	,, 21	479	— 98	14,855	+ 440	5	—
B.E.T. Co.	Dudley—Stourbridge..	,, 21	892	+ 50	27,754	+ 2,899	18½	—
B.E.T. Co.	Gateshead	,, 21	916	+ 45	28,716	+ 4,468	10½	+ ½
B.E.T. Co.	Gravesend—Northfleet	,, 21	296	+ 94	7,816	+ 344	3½	—
B.E.T. Co.	Greenock—Pt. Glasgow	,, 21	710	+ 62	18,068	+ 1,449	7½	—
B.E.T. Co.	Hartlepool	,, 21	347	+ 18	8,967	+ 468	6½	+2
B.E.T. Co.	Kidderminster	,, 21	142	— 13	4,393	+ 217	4½	—
B.E.T. Co.	Merthyr	,, 21	199	— 6	6,585	— 229	3	—
B.E.T. Co.	Middleton	,, 21	430	+108	10,828	+ 1,337	8½	—
B.E.T. Co.	Oldham—Ashton ..	,, 21	654	— 36	19,185	+ 1,597	8	—
B.E.T. Co.	Peterborough	,, 21	178	—	4,843	—	—	—
B.E.T. Co.	Poole	,, 21	432	+ 54	10,030	+ 1,543	8½	—
B.E.T. Co.	Potteries	,, 21	1,459	+ 40	51,543	+ 2,825	28½	—
B.E.T. Co.	Rothesay..	,, 21	417	+ 52	5,272	+ 1,663	2½	—
B.E.T. Co.	Sheerness	,, 19	98	—	1,872	—	2½	—
B.E.T. Co.	Southport	,, 21	497	+ 16	10,461	+ 1,960	5½	—
B.E.T. Co.	South Staffordshire ..	Aug. 21	1 049	+806	£9,232	+ 3,364	21¾	—¾
B.E.T. Co.	Swansea	,, 21	597	+ 41	17,986	+ 1,505	5¼	—
B.E.T. Co.	Taunton	,, 21	84	— 12	2,053	— 177	1½	+1½
B.E.T. Co.	Tynemouth	,, 21	526	+ 71	10,721	+ 1,044	3½	—
B.E.T. Co.	Weston-super-Mare..	,, 19	337	— 30	8,992	— 313	2½	+2½
B.E.T. Co.	Wolverhampton Dist.	,, 21	397	+ 88	13,096	+ 6,674	10½	+8
B.E.T. Co.	Wrexham	,, 21	142	—	2,955	—	—	—
B.E.T. Co.	Yorks. Woollen Dist..	,, 21	469	—	8,768	—	6	—
	Cardiff	,, 29	2,085	+149	44,123	+13,889	14	—
	Chatham & District Co.	,, 27	663	+113	17,908	+12,842	8·53	—
	Dover	,, 29	289	— 30	7,749	+ 56	3	—
	Dublin	,, 28	6,097	— 16	51,077	+ 6,463	46	—
	East Ham	,, 29	734	+177	15,312	+ 4,859	6	+ ½
	Glasgow	,, 29	13,785	+1280	173,731	+19,498	65	+10
	Hull	,, 29	1,314	+ 41	40,226	+ 1,860	11	+ 1
	Ilkeston	,, 26	184	—	—	—	4	—
	Isle of Thanet	,, 29	1,671	—216	24,207	— 740	10½	—
	Leeds	,, 22	5,630	+511	120,108	+ 7,349	41	—
	Liverpool	,, 22	10,473	+ 603	339,684	+12,141	100	+1½
	Manchester	,, 29	11,681	+ 6086	260,067	—	72	—
	Newcastle	,, 29	3,505	+ 511	—	—	17	—
	Portsmouth	,, 24	2,390	—191	—	—	29	—
	Salford	,, 24	3,856	+1135	79,469	+24,703	30	—
	Southampton	,, 13	1,270	—	—	—	9	—
	Sunderland	,, 28	1,506	+116	27,085	+ 1,308	20	+3
	Central London Railway	,, 29	5,499	—133	55,485	— 1,778	6	—
	City and S. London Ry.	,, 30	2,403	—134	21,859	— 2,819	6½	—
	Dublin and Lucan Rlwy.	,, 30	166	+ 3	1,394	+ 61	6½	—
	Liverpool Overhead Ry.	,, 30	1,636	+ 76	15,520	+ 882	6	—

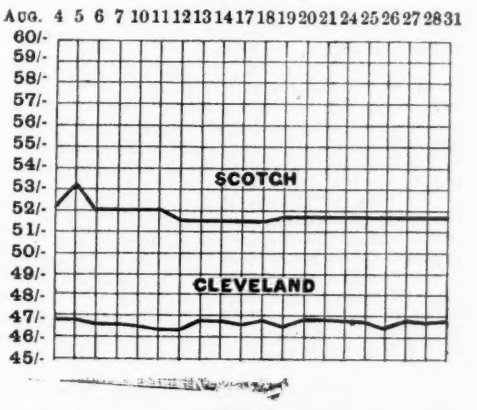
* Compared with the corresponding period of 1902.

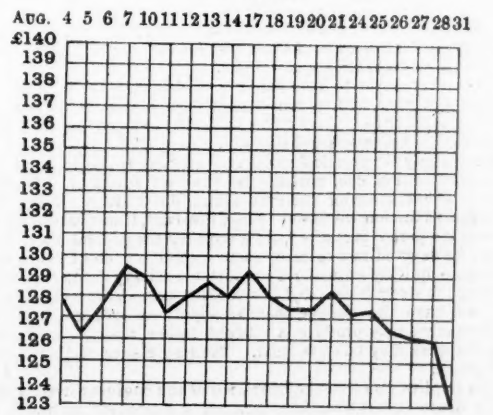
METAL MARKET.

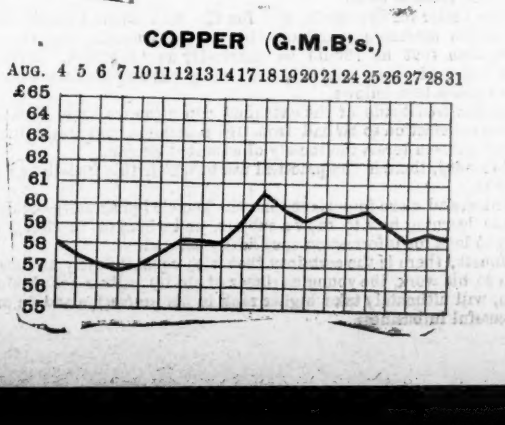
Fluctuations in August.











AMERICAN ELECTRIC CENTRAL STATIONS.

In our issue of August 21st we gave some statistical particulars showing the position of electric tramways and railways in the United States. There has now been issued from the U.S. Census Office a similar report dealing with electric light and power plants, and stating the position for the year ended on June 30th, 1902, the same period as the traction particulars covered:—

Central Electric Light and Power Plants.

	Total.	Private.	Municipal.
Number of establishments	3,619	2,804	815
Cost of plants	$502,181,511	$480,161,033	$22,020,478
Earnings from operation	$93,585,410	$76,748,554	$16,836,856
Expenses	$67,688,075	$62,442,008	$5,245,987
Power-Plant Equipment.			
Steam engines.			
Number	5,921	4,861	1,060
Horse-power	1,377,041	1,230,023	147,018
Water-wheels.			
Number	1,378	1,296	82
Horse-power	381,134	369,916	11,218
Generating Plant.			
Dynamos.			
Direct current, constant voltage	3,820	3,402	418
Number	—	—	—
Horse-power	441,621	418,088	23,534
Direct-current, constant amperage	3,587	2,955	632
Number	—	—	—
Horse-power	195,481	157,668	37,703
Alternating and polyphase current	5,106	4,284	822
Number	978,428	887,740	90,688
Horse-power	—	—	—
Output of Station.			
Kilowatt-hours, total for year	2,437,218,732	2,241,314,293	195,904,439
Line Construction.			
Miles of mains and feeders	12,470,494	10,936,603	1,533,891
Lighting Service.			
Arc lamps.			
Total number	385,208	334,413	50,795
Commercial or private	178,502	167,709	5,793
Public	211,706	166,704	45,002
Incandescent lamps.			
Total number	18,006,521	16,429,060	1,577,461
Commercial or private	17,542,756	16,058,111	1,484,645
Public	463,765	370,949	92,816
Average Number of Employes and Total Salaries and Wages.			
Salaried officials and clerks	6,976	6,026	950
Salaries	$5,632,880	$5,175,499	$457,381
Wage earners	28,258	25,791	2,467
Wages	$14,919,109	$13,496,768	$1,422,341
Foreman and inspectors	1,560	1,478	82
Wages	$1,358,272	$1,297,585	$60,687
Engineers and firemen	6,060	6,671	1,389
Wages	$5,201,988	$4,416,929	$785,059
Linemen	4,209	3,860	349
Wages	$2,704,529	$2,503,967	$200,574
All other employés	9,469	8,782	687
Wages	$5,654,320	$5,278,197	$376,023

The New York *Electrical World and Engineer* in a short editorial comment on the two sets of statistics, of which we have given a summary, says "there are so many points of interest in these official and first authentic figures that it will take some time to digest and comprehend them. It may be noted primarily that in power plant capacity the lighting and trolley industries are very much on a par. The street railways have just about 1,300,000 H.P. in engine and water wheel capacity. The lighting plants have just about 1,750,000 H.P. The output for the street railways was returned at 6,249,910 kilowatt-hours per day, or 2,261,484,397 for the year. The lighting plants report an output of almost the same figure, namely, 2,437,218,732 kilowatt-hours for the year, or 6,677,310 per day; so that while the output of the lighting plants is half a million kilowatts larger daily, the plants run fewer hours. This is quite in accordance with observation. The dynamo capacity of the railways is 1,204,238 H.P., while the dynamo capacity of the lighting plants is 1,615,480 H.P. Reducing this to kilowatts, it would appear that the capacity of the railways is in full use nearly eight hours daily, while the capacity of the lighting plants is in use about six hours daily.

"After all, this is a rather surprising result, for a street railway system is understood to be in operation pretty well all around the clock, while lighting is necessarily limited to a few hours. On the other hand, the development of day circuits for power purposes has come in of late years to increase hugely the output of the lighting plants, while it is obvious that there must be many trolley systems that taken the year through would not average as many hours of operation as a busy lighting plant. In each case the controlling, economic idea must be to increase the number of hours of operation, for upon that item depends capitalisation and return in dividends."

FOREIGN GAS ENGINES AT ST. LOUIS EXPOSITION.

The *Scientific American* gives the following interesting particulars respecting the gas engine exhibits at the 1904 World's Fair at St. Louis:—The power plant of the forthcoming World's Fair, St. Louis, will contain among other items a 3,000-H.P. gas engine, the

product of Société Anonyme John Cockerill, Seraing, Belgium. This engine, it is believed, will be the largest gas engine in service up to the time of its installation. The World's Fair power plant will, we understand, embrace more than 40,000 H.P., and the installation will be wholly within the buildings comprising the machinery department of the exposition. For the most part, the prime movers of the power plant will be placed on either side of the main aisle running the full length down the centre of Machinery Hall. This aisle will be about 1,000 ft. in length. The engines comprising the driving power of the exposition will include gas engines, turbine engines, and high-speed steam engines; but by far the most interesting feature of this power plant must be the gas engine display.

The 3,000-H.P. gas engine, above referred to, has two cylinders, each having a diameter of 51 in. The length of stroke is 55 in. and the revolutions per minute when developing 3,000 H.P. will be 85. The length over all of the engine is 67 ft. 1⅛ in. The bed-plate or foundation proper will have a length of 77 ft. 6 in. The foreign exhibits for the St. Louis power plant were gathered by Lieut. Godfrey L. Carden, R.C.S., of the machinery department of the exposition, who was detailed by the Secretary of the Treasury for service at St. Louis. He has been engaged for nearly nine months in Europe in collecting late-type units for the machinery department, and more power was turned in by foreign manufacturers than could be used at St. Louis.

While the John Cockerill gas engine will represent the largest gas engine in service up to the spring of 1904, Lieut. Carden informs our contemporary that when he was at the works of the Gasmotorenfabrik-Deutz, Deutz, near Cologne, Germany, he found that that establishment was engaged in completing designs for a 6,000-H.P. gas engine, and that the statement was made to him that by 1905 gas engines of this unprecedented size would be put on the market. When one considers the relatively small units in which gas engines are built in America, the advanced stage of the gas engine industry in Europe must be at once apparent. In addition to the John Cockerill engine there was secured a 1,600-H.P. gas engine of the Oechelhauser type, the product of the house of A. Borsig, of Tegel, near Berlin. The Borsig engine will be attached to a Crocker-Wheeler electric generator, and the gas producer will come from the German house of Julius Pintsch, of Berlin. The Pintsch gas producer will have a capacity sufficient for developing 2,400 engine H.P. The total weight of the shipment from Tegel will approximate 660 tons.

A 1,800-H P. gas engine of the Nuremberg type will also be put in service at St. Louis. The drawings of this engine show a length over-all of 60 ft., and a breadth between extremes of 19 ft. 4 in. The fly-wheel will measure 18 ft., and at 1,800 H.P. the number of revolutions will be 92 per minute. Large as this fly-wheel is, it will be exceeded by that of the John Cockerill engine, which will be 26 ft. 3 in. in diameter.

Aside from the gas engines displayed at St. Louis the exhibit of high-speed steam engines is bound to attract great interest, for it must be admitted that in the matter of high speed engines of large powers, Americans have not made so much progress as foreign manufacturers. The house of Delaunay-Belleville, of Saint Denis (sur Seine), France, will send to St. Louis a complete unit of 1,500 H.P., embracing a high-speed vertical triple-expansion engine, with boilers and generator complete. This engine will operate ordinarily at 325 revolutions per minute. Another high-speed engine is a 1,200-H.P. unit of the Willans & Robinson, Rugby, type. Among the famous foreign engine builders who have made offerings for the St. Louis power plant are Franco Tosi, of Legnano, Italy, a 2,500-H.P. steam engine; Carels Frères, Ghent, Belgium, a 2,500-H P. steam engine; Augsburg-Nuremburg, Nuremburg, Germany, a 2,500-H.P., vertical triple-expansion engine; Greenwood & Batley, Leeds, England, a 300-H.P. turbine engine; Société Alsatienne de Constructions Mécaniques, Milhausen, Germany, a 1,000-H.P. tandem engine with direct-connected dynamo.

It is added that the Machinery Hall of the St. Louis Exposition is already applied for several times over.

THE PROBLEMS THAT ARE FACING THE ELECTRICAL ENGINEER OF TO-DAY, AND THE QUALITIES OF MIND AND CHARACTER WHICH ARE NEEDED TO MEET THEM.*

By J. G. WHITE.

The qualities of mind and of character needed by the electrical engineer of to-day are too well known to need to be specified.

He should be accurate in his calculations, thorough in his investigations, logical in his deductions, lucid and concise in his statements.

He should have untiring energy, an alert mind, abundant initiative, and reasonable self-confidence.

He should be absolutely honest in all his dealings, truthful in all statements, loyal to his clients, faithful to his employer's interests, considerate of his subordinates, diplomatic in his negotiations and tactful in all his relations.

However, instead of attempting to rear a structure on the foundation of the text assigned to us, may we not rather use it as a springboard from which to vault into the general field under discussion to-day?

This might be summarised under the title: "What education should the electrical engineer of to-day have?"

As is frequently remarked, this is the age of great industrial combinations and of specialists. Not satisfied with this, the specialists now specialise. The engineering field was formerly divided into the two general classes of military and civil engineers. From the latter gradually developed marine, mining and mechanical engineering, and as an offshoot from this last branch, there was recently added electrical engineering. Civil engineers to-day are sub-divided into such classes as "hydraulic engineers," "bridge engineers," "railroad engineers," &c. We also find that electrical engineers are classified as "telegraph engineers," "electric light engineers," "electro-chemical engineers," "telephone engineers," &c. A few years ago many of us would have supposed that the problems of the "telephone engineer" were those of a high-class artisan, and that they would consist largely of trying to unravel tangled cobwebs of fine wires, and to understand and to be able to operate mazes of signalling, connecting and protecting devices.

In the early days it was thought that a room of almost any shape and size, with a couple of empty boxes for seats, and a switchboard of primitive design and construction, was all that was needed to make a telephone exchange. Owing to the wonderful growth of their business, telephone companies now erect buildings specially designed to meet the requirements of their exchanges, and a "telephone engineer" must know something of architecture, the strength of materials, and other factors entering into modern steel-building construction, and many other subjects which should be a part of a broad engineering education, but which are not ordinarily supposed to come within the province of a "telephone engineer" as narrowly applied.

It is at least equally important that other engineers who have specialised and must know well some part of the field of engineering should likewise have a general knowledge of the science and of the broad underlying principles of engineering, based on a thorough mastery of elementary mathematics, and supplemented by some study of languages, history, civics, and other studies of general educational value.

The question naturally arises, How can the engineering student possibly secure a satisfactory knowledge of all of these important subjects? Much of his special knowledge must be acquired after he has commenced the practice of his profession. If unusually energetic and capable, all or any part of his education may be gained after he enters professional life, but it is preferable that his broader education be well started during his school years. For a considerable time it has been clearly recognised that law and medicine require, for general and special study, more time than is possibly available in the ordinary college course of four years.

If lawyers and doctors can afford the time and money necessary to get such educations, should not engineers, in view of the very wide range of subjects with which they must now be reasonably familiar, adopt a similar plan? The decision of this question will have to be made individually by the young men themselves, important factors being the time and money available for educational purposes.

It is well to remember, however, that more important than a knowledge of any study, or group of studies, is the ability to master thoroughly any subject of which a knowledge is desired.

In education especially quality is more important than quantity. A thorough mastery of arithmetic and algebra is better than a mere "pass grade" knowledge of these and all the higher mathematics, which is then ordinarily soon forgotten.

It is better never to have seen the inside of a Latin, French or German grammar, and to use correct English, than to have the ordinary three or four years "translating knowledge" of all three of these foreign languages and still say, "I seen."

As in nearly all practical engineering problems, this one of engineering education can, perhaps, be best set forth by arranging a balance sheet showing the credit and debit sides. Against the extended education we have expense involved, time necessary before the earning period is reached, time required for general study which might be devoted to mastering some special branch of engineering, thus more quickly ensuring a comfortable salary, danger to health if too much study is crowded into a given period, &c. On this side, also, we have the danger that by widely extending the field of endeavour we may produce a student rather than an engineer, or that the work may be superficial. The importance of thoroughness is supreme.

This implies also that the education of the engineer must develop not a dreamer, but a worker, thoroughly competent in his sphere, whether great or small.

It is better for the world and for the man that he should be a high-class mechanic or artisan, with a good common school education, than that he should be nominally an "engineer," having a smattering of many subjects, and ekeing out an existence amongst more competent fellows.

On the credit side of the extended education we have, first, the direct satisfaction to be had from its possession and the ability to enjoy on even terms the society of educated people.

Secondly, there is the practical use to which this knowledge can be put.

Third, and more important than the knowledge actually acquired, is the learning how to know a subject, and where or in what direction to look for information specifically wanted.

Fourth, there is the certainty that with equal industry and attention to his work, the young engineer of ability, with a broad education, will ultimately take higher rank in his profession and be more successful in business.

* Abstract of paper read at the joint session of the American Institute of Electrical Engineers and the Society for the Promotion of Engineering Education, Niagara Falls, N.Y., July 3rd, 1903.

The qualified phrase, "young engineer of ability" is used advisedly. The engineer of ordinary or less than ordinary ability will, in practical life, accomplish most by not attempting to have his education cover too wide a field, and learning some special department thoroughly. If a young man will take for his motto "thoroughness," and, in planning his list of studies, will include first those of prime importance, and then add those of decreasing importance, until all his available time is occupied, he will be planning most wisely. Ordinarily the young man will not be able to arrange a course entirely to suit his individual requirements, but he can use the method above suggested to help him in deciding as between various courses offered. The choice should, when time and mental capacity make it possible, be in favour of a broad general education, supplemented by thorough technical training. This may, and frequently will, lead to a general college course to be followed by a technical course of two or more years.

People are to-day looking for engineers and would gladly pay salaries of $6,000 to $10,000 per annum for men of exactly the right qualifications. It would be easy to find hundreds of men who have had all the necessary general education, and scores who have had as well all the needed technical training. The questions which are asked, however, are such as the following:—

Has he good business judgment?

Has he tact?

Has he the mental capacity and breadth to develop into a "big man?"

Is he diplomatic, with ability to negotiate?

Has he initiative, without being erratic?

Will he get results?

We might divide the studies which are worthy the attention of the electrical engineer into four general classes.

In the first place, we may put those studies which will teach to think clearly and express lucidly, which will teach how to learn, and will give a comprehensive knowledge of the fundamental facts and principles underlying his profession. These should be learned most thoroughly, and would include English, arithmetic (mental and written), algebra, geometry and trigonometry, chemistry, physics (especially mechanics), general knowledge of principles of electrical engineering, practical ethics.

The second class may include some subjects which will especially tend further to develop clear thinking and clear writing, some which will further increase the knowledge of the general principles of his profession, and some which will give knowledge which will be professionally and commercially useful. This class includes: Calculus and vectors, surveying, Latin (usual preparatory course), French (speaking and reading, not translating knowledge of), electro-chemistry, advanced engineering studies, business law, general principles of modern accounting, civics.

The third class may include some subjects which are likely to be of direct professional or commercial use, and others, the study of which will be of general educational value. This class includes Spanish, geology, physiology and temporary care of injured, logic, quaternions and subjects which are studies of engineering details rather than of general principles, &c.

The fourth class may include those studies which will help in rounding out the education of the man rather than in furnishing the essential equipment of the engineer. This class includes, Mineralogy, botany, zoology, history, political economy, mental and moral philosophy, art, music, &c.

The third and fourth classes of subjects are useful to round out and complete the foundation and framework provided by the first and second classes, but should not be indulged in at the expense of the relatively more important. A few non-technical subjects merit individual mention.

President Butler, of Columbia University, is reported to have said:—"The first two evidences of an education are correctness and precision of speech, and refined and gentle manners." The latter must be acquired almost entirely at one's home and from contact with one's associates. The correct speech must be acquired largely in the same way, but may be learned to a considerable extent in the preparatory schools and in the college or university. There is nothing more important for the young engineer to learn than "the skilful and correct use of language, whether to state a fact or convey an idea," understanding that "clear thinking precedes clear speaking." English should be taught from beginning to end of the preparatory school work, and also from beginning to end of the college course.

More attention may well be paid in the preparatory schools to algebra and arithmetic, especially mental arithmetic.

During the college course it would seem advantageous even for the electrical engineer to devote a moderate amount of time to the study of the various methods of surveying now practised. These can be quickly understood if the student has thoroughly mastered his arithmetic, geometry and trigonometry, and a general knowledge of surveying is very likely to be useful in practical work

French and Latin are included in the second class because of the mental training and polish to be gained by their study. Some knowledge of Latin will greatly assist in thoroughly mastering English, and is in this respect more useful than the study of German.

A knowledge of French which will enable the young engineer to speak and read with ease is strongly recommended. The educated people of Mexico, South America, Russia and other countries speak French, and as this for centuries has been the polite and diplomatic language of the world, the advantages to be derived from mastering it are likely to be not only educational and social, but commercial as well.

On the contrary, there is little prospect that American engineers can practice their profession profitably in Germany or German-speaking countries. Nearly all important scientific papers are now promptly translated into English, and there is no longer any special need of the engineer knowing any foreign language for the sake of keeping advised as to the progress made in the work of his profession.

The general educational value of learning one modern language seems about equal to that to be gained from learning another. Consequently the social and commercial advantages of French give it first place for the American engineer.

The study of a second modern language should be undertaken only in case the first can be spoken fluently. Then it would seem that Spanish is the best language to learn.

The time devoted to various engineering studies in Class 1, as well as Class 2, must depend largely upon the facilities of the college attended, and the special work for which it is intended to prepare.

Somewhere in the general course there should be included a moderate amount of training in modern business methods and practices.

All engineering students should have some reasonable training in accounting, so that they would not be entirely ignorant and without power of speech if, after beginning the practice of their profession, they are asked some elementary questions about the annual report of a street railway, electric light or manufacturing company.

A moderate amount of time should also be devoted to the study of fundamental principles of business and corporation law. An engineer, in practice, should at least be able to draw a contract which will be legal and explicit.

A modern engineer is dependent for his success largely on the financier. If the engineer does not know that bonds should pay interest, and that stocks, if possible, should pay dividends, and has no conception of the difference between a stock certificate and a promissory note, the financier is likely to form an undeservedly low opinion of the engineer's technical knowledge.

If a young engineer will have before him constantly the ultimate and best interests of his employer, will endeavour always to be tactful and never to irritate unnecessarily, will—without flattery—say only what is pleasant, unless right demands a plan statement of an unpleasant truth, then his advance will surely be more rapid than if these things are forgotten or neglected.

The technical problems which face the engineer are certain to be recognised as they come up. Too frequently the importance of problems connected with one's business and social relations with employers, fellow employés and others is not appreciated. These deserve careful and persistent study. Their correct solution and an accurate appreciation of the proper proportion of things, constitute business sagacity. The paramount importance of such matters should be repeatedly impressed on students, and they should be led to understand thoroughly that their satisfactory solution will be rewarded not only by a pleasanter life during working hours, but also by increased esteem and greater business success.

ON A NEW METHOD OF TUNING WIRELESS TELEGRAPH STATIONS BY MEANS OF THE "MULTIPLIER."*

By COUNT ARCO.

I.—Importance of Resonance.

All experts are now agreed that the most important advance in the development of wireless telegraphy consists in the recognition and proper application of the law of electric resonance.

The first to avail himself of the resonance effects of currents of high frequency, to obtain powerful effects was undoubtedly Tesla. Since he, however, only allowed very scanty information as to the means he adopted to be published, he long remained the sole master of the method. Marconi, in England, was the first to obtain a great success by the application of resonance in wireless telegraphy. At present resonance is universally applied in wireless telegraphy in all the numerous alternating-current circuits of the system, whether low or high frequencies are used.

In the following remarks we shall, however, assume the simplest arrangements, and consider the law of resonance and its application to vibration systems of *high* frequency only. We shall briefly describe those principal vibration systems which must be attuned to resonance.

In fig. 1, I represents the transmitter and II the receiver. Each consists of a straight aerial wire earthed at the bottom, which, when used as a transmitter (I), is thrown into electric vibration by the exciting circuit. E, and when used as a receiver (II) by the action of the distant transmitter. Each aerial wire has an inductive coil, consisting of a few turns, by which connection is made with the exciter during transmission and with the wave-detector, J, in reception. Both vibrate in a quarter-wave length or in an odd multiple of quarter wave lengths, whilst the image of this vibration system is produced either in the earth, as shown, or in an equivalent "counterpoise."

The exciting circuit of the transmitter I consists of high-tension condensers for storing the energy, a spark-gap and a small amount of self-induction. When the condensers are discharged through the spark-gap, vibrations of definite frequency are produced, the period of which is determined by the self-induction and capacity of the circuit. In the receiver the indicator circuit, like the exciting

* Translation of article in the *Elektrotechnische Zeitschrift*, January 1st, 1903.

circuit in the transmitter, is made up of self-induction and capacity; but in this case there is more self-induction and less capacity than in the transmitter.

The connections of the exciter and indicator circuits with the aerial wire will be described further on.

Resonance must be established:—

1. Between the exciter and the vibrations of the aerial wire (tuning of the transmitter circuits).

2. Between the fundamental vibrations of the aerial conductors at the sending and receiving stations.

3. Between the fundamental vibrations of the aerial wire at the receiving station and the indicator circuit (tuning of the receiver circuits).

II.—Previous Methods of Tuning.

The practical methods hitherto adopted for ascertaining whether resonance had been obtained between the fundamental vibrations of the various systems were as follows:—

(*a*) Resonance between the parts of the transmitter itself.

Resonance between the exciting circuit and the vibration of the transmitter was most conveniently obtained by means of a hot-wire ampere-meter (range from about 0·1 to 0·5 ampere) furnished with a shunt of variable self-induction, and inserted in the aerial wire

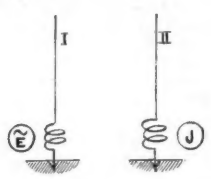
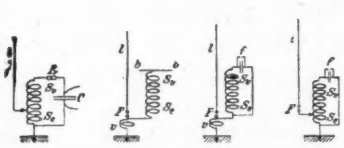


Fig. 1.

at the point of current wave-crest. The frequency of the transmitter was then varied until the maximum amount of current was taken up by the aerial wire. The capacity of the exciting circuit in the Slaby-Arco arrangement may be regarded, for the various types of apparatus, as a fixed quantity. It is chosen so large, that the coil used is always fully loaded. On the other hand, the periodicity of the primary is so regulated that the self-induction of the secondary of the induction coil or transformer, in combination with the capacity of the Leydens, is also in resonance with the slow vibrations of the primary circuit.

The determination of the resonance by ascertaining the maximum absorption of current is, for practical reasons, preferable to measuring the spark length, as the current crest of the transmitting wire is always accessible, but the potential crest is not. Moreover, spark measurement only indicates the amount of *energy* absorbed



Figs. 2, 3, 4 and 5.

by the transmitter, whilst the current is a measure of the radiated energy, and, therefore, of the effect produced at a distance.

(*b*) and (*c*)—Resonance of the receiving wire and of the parts of the receiver itself.

Greater difficulty has hitherto been experienced in tuning the receiver to the transmitter, and the parts of the receiver to each other. This may be shown by an example:—

Suppose a coast station to be already working, and that several ship installations tuned to it are also working. If now one or more ships had to be newly installed and their receivers tuned to the same station, the only method available was to obtain approximate syntony by actual trial. With a fast steamer going at 20 knots, and having commercial messages for transmission to land, there was little time to spare, and careful tuning could seldom, and only with great difficulty, be obtained. The discovery of a method of tuning the receivers beforehand therefore means an extremely valuable practical advance.

III.—New Methods of Tuning.

The characteristics of the new method will be most readily seen from the original experiments made in August, 1901. One and the same signal was sent continuously by a single transmitter and the dimensions of the tuning coil were determined as accurately as possible for three different stations all connected with aerial conductors of different lengths. Fig. 2 represents the arrangement of the receiver; l = aerial wire, s_v = shunt coil, s_e = earth coil, F = coherer, E = earth, and C = condenser (to which the relay and coherer cell are joined up in parallel). Instead of this method, the arrangement of the receiving apparatus first adopted by Lodge and afterwards by Marconi and many others, in which there was simply an inductive connection of the indicator circuit (transformer arrangement of the receiver) might just as well have been used.

The experiment showed that at all three receiving stations with very widely differing lengths of aerial wire, the dimensions of the coils s_v and s_e, when resonance was obtained, varied in each case, and in such a way that for the shortest aerial wire the greatest value of s_v was required; the *sum* of the two coils, however, always remained constant. Now, as the coils, the coherer, and the condenser are connected in series, and as apparently all three indicator circuits, when resonance was obtained, were tuned to the same rate of vibration—namely, that of the common transmitter—it follows that the capacity charge of the coil circuit, consisting of the combination, in series, of the coherer and the condenser C was a constant. The capacity of the condenser C is about 0·01 microfarad. Since at the transmitting station the product of self-induction and capacity was about 1,000 times smaller than $(s_v + s_e) \times C$, it follows that the capacity C could not be effective in tuning the receivers, but that—

1. The coherer, before it responds, and so long as its ohmic resistance is infinitely great, forms a condenser; that

2. Its capacity is very small, so small in fact, that the capacity of C when the two are joined in series is infinitely great in comparison; and that

3. The coherer capacity alone in combination with the self-induction of s_v and s_e is effective in the tuning of the indicator circuit.

It now became a question of measuring the capacity of the coherer, and the following method was adopted.

With the same transmitter as was used in the experiment just described, the inductance coils s_v and s_e used for the three receivers were arranged as shown in fig 3. The upper end of the coil was loaded with the capacity of a wire $b - b$, the length of which was varied until the attached coil, acting as a multiplier, showed that it was in resonance with the frequency of the transmitter. The capacity of the wire $b - b$ was then equal to that of the coherer. The only assumption here made is that the self-induction of the stretched wire is infinitely small compared with that of the coil $s_v + s_e$, which appears to be quite permissible.

The coherer capacity might be defined by the following wire capacity:—

Length $b - b$ = 350 cm.
Diameter of wire = 1 mm.
Distance of wire from ideal earth about 100 cm.

This method has one disadvantage. The difference between the proximity of the absolute earth, and the proximity of other earthed

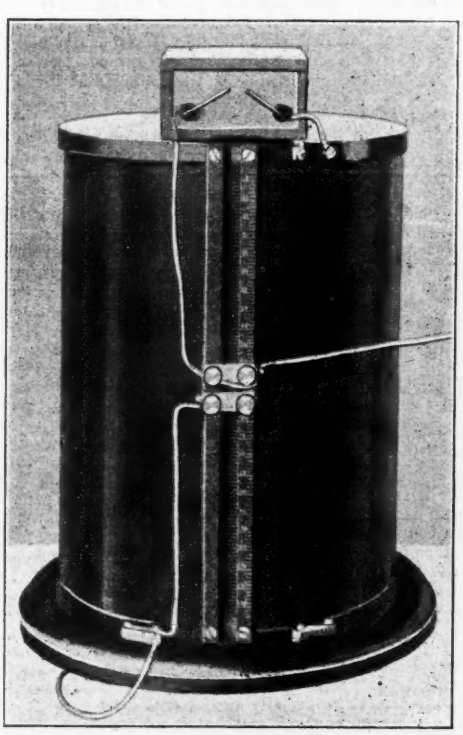


Fig. 6.

conductors give, especially on board ship, unreliable and varying values. The stretched wire was consequently replaced by a glass plate condenser, the dimensions of which were:—

Area of coating, 14 sq. cm.
Distance between coatings, 0·5 cm.
Dielectric constant of the glass about 7.

We shall call these condensers, for brevity, "coherer condensers," and their electric capacity "coherer capacity." The connections of the coherer condensers are shown in fig. 4. Tuning is determined by the length of spark in the spark gap, f, which is in parallel with the coherer condenser. In the older arrangement (fig. 3) the high frequency currents of the measuring coil system pulsate between the wire $(b-b)$ representing the coherer capacity and the earth, and consequently flow through the self-induction of the coil, v, of the aerial wire, so that this coil is included in the measuring system. The self-induction of v has, therefore, to be

added to the self-induction of the measuring coils. The advantage of the new arrangement is that the inductance, v, is now outside the measuring system, since the coherer capacity is connected directly with the poles of the measuring coils.

After the coherer capacity had been determined once for all, and it had been proved that such capacity varied but little (at least in the vacuum coherers with wedge-shaped gap made by the A.E.G.) in different specimens, it became possible to tune receivers beforehand by this method.

The process is as follows:—

A coil with which the coherer capacity is connected, and which must have precisely the same constants as the coil which is to be used later for a particular receiver is connected with the transmitter, and its length or number of turns varied until it is in resonance with the vibrations of the transmitter. The length of this coil or its number of turns is then equal to the sum of $s_v + s_c$. The separate values of s_v and s_c may now be found as follows:—

The aerial wire at the receiving station is thrown into vibration, not by a distant transmitter, but by any sort of excitation—by inserting, for example, an estimated value of s_c between the aerial wire and earth, as in the old Marconi arrangement (*vide* fig. 5), and then varying this value of s_c until the measuring coil, with its coherer capacity, is in resonance with the vibrations of the aerial wire. s_v and s_c are thus separately determined, and the receiver itself is also thereby tuned, if by a previous determination of $s_v + s_c$ it has already been tuned to the transmitter.

A practical form of the receiver coil is represented in fig. 6. The values s_v and s_c may be easily and quickly varied by simply sliding the contacts. The coil is shown with the coherer capacity joined up. In the latest forms the windings of the coils which are not inserted are short-circuited by one or more short-circuited pieces to prevent their taking up the vibrations.

Recently we have omitted the coherer capacity, and have determined once for all a reduction-factor by which the number of turns of the coil is to be multipled in order to obtain the number of turns required for the coil when connected with the coherer capacity. This factor for the Slaby-Arco coherers and standard coils is 0·54. When the number of turns necessary for tuning has been found for the coil without the capacity, this number must, therefore, be multipled by the above factor to obtain the correct number of turns $s_v + s_c$.

This method was designed by the writer, and has given excellent results in many cases.

(To be continued.)

INSTITUTION OF ELECTRICAL ENGINEERS.

(Calcutta Section.)

ON THE PRESERVATION OF INSTRUMENTS AND MACHINERY IN BENGAL.

By Paul Brühl, Member.

(*Paper read at Calcutta, March 27th*, 1903.)

(*Concluded from page* 360.)

Mr. Simpson had found that nothing keeps an instrument in such good order as constant daily use. He had in use a bridge and galvanometer for over 30 years, and though it had naturally deteriorated in appearance, its work was as good to-day as when erected. As regards telegraph and telephone instruments. In these instruments it is impracticable to avoid the use of wood, but all wood-work must be dove-tailed or screwed together, and no reliance whatever can be placed on glue. Also the instrument must be so designed that its proper working is quite independent of any warping or shrinking of the wood which may occur. He stated that they had in the Telegraph Department used German silver wire for their resistances and found it last very well. They were, however, now experimenting with some of the other materials on the market. He believed that accumulator cells deteriorated more rapidly in India than in more temperate climates, and he suggested this might be due to the increased chemical action caused by the prevailing high temperature.

Mr. Reynolds remarked that the condition of cases on receipt depended very largely on the time of the year when they came through the Red Sea. The manufacturers insist on using straw to a large extent, and in hot weather it invariably rots and causes damage. He got a case where a few straws fell and adhered to a greased shaft, and when opened in Calcutta the rust had eaten into the steel. A large engine packed in England for transit to Calcutta was fixed into the packing case by wedges driven in between the cylinder lagging and the case, with the result that considerable damage was done. The speaker believed American packing to be the best, and suggested that this might be due to the extremely rough handling which cases received in America, as pointed out in the paper. He stated that nearly all the ordinary types of instruments rapidly deteriorate when kept in Calcutta; so that after a short time it was not unusual to find inaccuracy amounting to 5, 10, or even 20 per cent. In one case a potentiometer was sent out to him packed in such a way that when opened up it fell to pieces, and yet when it was returned to the manufacturers packed in exactly the same way, they complained!

Mr. Shields said he remembered some delicate instruments being sent out by a firm in Paris. They had been most carefully enclosed in a tin-lined case; but the packing consisted of straw which had not been dried. The instruments were in consequence subjected on the way out to a vapour bath for several weeks, and all the iron parts were one mass of rust. Manufacturers at home were very fond of gluing parts of instrument cases together. This was fatal for use in this country; the glue invariably gave way sooner or later. The paraffin running out of coils of wire sometimes gave a good deal of trouble. A resistance box was sent to him for test some little time ago; the paraffin had run out of the coils, the damp got in, and in consequence the resistance box had an electromotive force of its own. Adding resin to the paraffin makes it harder; but it is not so clean.

Mr. Williamson remarked that the best way of keeping cases the right side up during transit was to fix battens underneath them, which would lend themselves to the shifting of the case on rollers, and which would show better than any label how the case was intended to be placed. In the case of instruments, he suggested that it might be possible to avoid damage due to moisture during transit by enclosing a small quantity of calcium chloride in a special cover inside the box, as is done by manufacturers of sensitive photo. papers, &c. The problem which was exercising him at the present time was the best method of keeping a very large number of spare parts, such as tramway motor armatures.

Mr. Pook: Packing is a lottery, and sometimes by good luck China goods arrive in good condition, but my experience of importing switches, fuses, and other China goods is that they are specially packed to pound each other to atoms; 25 per cent. of damages is an excellent percentage, and 40 per cent. is more often the rule. Tin cases are usually excellently made and watertight, but the result is disastrous if delicate instruments are packed in them with damp straw or shavings; nails are often driven through the zinc when fixing the lids and the case is sure to get wet and have the damaged side exposed to the water. My experience is that goods purchased from a small firm are almost sure to be badly packed, and any saving in first cost will be more than made up for by the loss of goods—and temper. An extra ¼ in. or ½ in. in the thickness of cases makes a lot of difference to their capability of being stove in, so does the quality of the wood used, and neither of these makes very much difference in packing charges or carriage.

Mr. Meares: I can add my mite to the chorus of condemnation, since I have had a number of breakages due to the same causes. Where coolie transit of goods is necessary in the hills, foreign manufacturers will undertake to keep the weight and size of nearly all packages within reasonable limits for the purpose, but the British manufacturer knows better and makes not the least effort in this direction with the result that much damage is sustained. It may be noted that natives of this country have not the remotest notion of shifting heavy packing cases by means of rollers and bars, or of opening the lids of the same by recognised methods. If these points were fully considered something would have been gained in the way of making the packing suitable for the treatment it is likely to receive. Again, it is no uncommon thing for a steel shaft to be packed without any protective grease or paint, and as likely as not the case in which it is enclosed will be extremely damp, so that the fact of soldering it up does not do the least good. Amongst recent examples that have come to my notice are the following:—A large and heavy resistance bridge, the ordinary travelling case of which was so constructed that it arrived with half the coils short-circuited and with some of the terminals broken off, while in the same packing case with it were some small Weston voltmeters! Again a switchboard for heavy testing currents arrived with the whole of the copper connections in ruined condition, so far as appearance goes, owing to the use of damp straw. Again a volt box with broken connection inside, presumably due to the same cause. On the other hand, I have just received a fine chemical balance which was packed as perfectly as skill and forethought could do it, with the result that it arrived intact.

The Chairman in closing the discussion, said that he had ordered three water thermometers from a German manufacturer; all arrived intact and were put away in a drawer, and sometime afterwards he found that they had all burst. On looking into the matter he observed that they were only calibrated up to 25° C., and that even the attached mercury thermometer only went up to 50°! In his experience very few coils had anything like proper insulation, all being too soft, and giving way in summer. The legs of statical instruments should on no account be fixed on with shellac. As regards packing, Father Lafont considered that it would be better to always get instruments out in parts and to set them up out here, since the users of electric instruments would generally be competent to do this, or should be so; the makers would then perhaps learn to pack the separate parts so as to be immovable, and he would suggest that they should give their packers a course of lectures on the subject of inertia, which they seem generally to ignore. Recently 56 cells of accumulators were supplied to a Paris firm to his order, and the firm in question sent the batteries on to him in the same case which had been used to forward them over the short inland journey, with the result that a large number of the plates arrived loose or broken. As regards rubber tubes and stoppers he inquired if there was any satisfactory method of keeping them. (Prof. Brühl here suggested glycerine as a preservative.) He stated that for ebonite, darkness was essential. With reference to a previous speaker's remark he suggested that the decomposition of unpolished ebonite would be greater than the unpolished article, as the rough surface, being less dense and hard, would probably be more easily disintegrated by exposure.

Prof. Brühl, in reply, said: The hardest paraffin used by microtomists, having a melting point of close to 60° C., seems to be quite solid enough for this country. The chief advantage of using ebonite in an unpolished state, especially in the case of corrugated supporting pillars, is that one can always get a fresh and highly insulating surface by giving it a few touches with fine glass paper. Some German makers, for instance, Haénsch & Schmidt, of Berlin,

have adopted, for the purposes of articles specially manufactured for tropical countries, what they call a tropical outfit, which I can highly recommend; all metal parts are strongly nickelled, and any Nicol's prisms, which, for instance, may form adjuncts of photometric apparatus, have their calcspar rhombs protected by coverglasses cemented on with Canada balsam. I have had some of Hæusch & Schmidt's instruments in use for more than ten years, and they look as if they had been got a few weeks ago. I, too, have had a great deal of trouble with silvered scales; in the case of high-class instruments, scales engraved on solid polished silver or some permanent alloy should be adopted. For years I have used a device to keep dry one of my balances as well as a Clifton electrometer. I have replaced the top of the balance case by a shallow box having a perforated bottom, and I place shallow trays containing pieces of fused calcium chloride into the box. The electrometer I have housed in an outer case with a similar top to it. Materials for drying the air should be placed on top; materials for absorbing carbonic acid should be kept at the bottom. As concentrated sulphuric acid begins to dissociate at about 30° C. with the formation of volatile sulphuric anhydride, sulphuric acid should not be used in this country as a desiccating agent, just as it cannot be used for most part of the year as an absorbent of water vapour in chemical analysis. As regards the incompetence of people often employed in Calcutta. Unfortunately to Europeans the cost of living in this country has become so exorbitant of late years, that if we want to employ Europeans as foremen and overseers, we must pay them wages which make their income the real and not only the nominal equivalent of what they would earn in England. As regards dynamos, the chief trouble one has is about insulation. I should advise my friends to specify that armatures and field magnet coils should have every layer of conductors well painted with good shellac varnish or some equally effective composition, and after finishing to have them well baked. Damp surroundings produce consumption, even in electric machinery. The spare parts which electricians have an opportunity to keep are most of them quite valuable enough to make it worth one's while to build a properly constructed store room for them. Such a store room must have a proper flooring; mud-floors are quite out of question. Parts specially liable to decay, like armatures, should be kept in a well aired, cleanly kept upper room. It is quite astonishing how vast a difference there is in this country between a ground floor and a first floor as regards dryness. Even during the driest part of the year—I speak of Lower Bengal—frictional electrical experiments rarely succeed with certainty before 10 a.m. and after 3 p.m., if tried in a room on the ground floor; and yet I have been successful as early as 7 o'clock in the morning in a room on the first floor with a low stratum of mist hovering over the ground outside. As regards wood joints, oblique dove-tailing is very effective; glued joints are worthless. Of course, manufacturers should only use the best seasoned wood.

I do not believe that the life of a good accumulator cell, provided the cell is carefully treated, is much shorter in India than in Europe. But I, too, have had a fearful experience with a battery. The type of cell was not the kind I had specified, although it was a cell the praises of which had been sung by more than one English authority and in more than one text-book. Luckily the company who manufactured that battery went into liquidation soon after and can do no further harm. But my battery was a sight really worth seeing, after it had been working for six weeks; every positive plate had buckled into the shape of a cocked hat; and you might straighten them as much as you liked, in a few days there you had your cocked hat again. I have never—before or after—done so heavy mechanical labour nor ruined as many pairs of boots and trousers, as I did during those ghastly three or four months, until we got the battery replaced by one consisting chiefly of Tudor cells. With me, Tudor cells—at least the majority of them—as well as the venerable E.P.S. cells have done very creditably; I have also been told that the Chloride cell has behaved well in a sister institution. Of course, I have always been very careful about maximum charges and discharges; my battery has been in work practically without interruption, and I have never allowed it to stand without its being charged up at frequent intervals. The accumulator cell will probably always remain a rather delicate plant. It would be very nice, if we could get a cell which would remain on its good behaviour, however much maltreated; but such a cell will probably not be invented, until the millenium dawns on a fagged-out world. I never use dry batteries. In my laboratory I use partly Leclanché cells, partly small accumulator cells of the ordinary type. I should like to point out to any of my friends, who have to order instruments, the advisability of completely specifying their requirements. After all we must not expect home-firms to find out themselves everything about the tropics. When ordering thermometers, I always specify that the capillary tube must end in a small reservoir of a sufficient capacity to receive the overflow mercury up to a temperature of 45° C. I have nearly always found the firms, Germans as well as English, from whom I have obtained instruments, ready to receive suggestions and to act on them. Now and then one does get to deal with a firm who think that they have nothing to learn; but as soon as I find that out, they get no further orders from me. On the other hand, I know of firms who have made special experiments on wood suitable for tropical climates. I know of a firm who have taken a great deal of trouble in trying to evolve a safe system of packing dynamos for shipment to distant countries. Neither of these firms are American. It is, however, a psychological riddle how certain firms can take a great deal of trouble over giving their goods a fine finish, and how immediately afterwards they pack them, so that not only all the fine finish, but the article itself is almost certain to be ruined.* Among the worst offenders are the packers of such things as switches, fuses, &c., especially anything that has porcelain parts about it. It is very easy to pack these articles so that they cannot be damaged during transit. The principle which should be acted on in packing fragile articles is to fix them rigidly to some rigid support, but to have the supporting frame suspended from or supported by springs, the frame being protected from excessive vibrations by layers of fine shavings. I have spoken about the probable influence of the sea voyage. In most cases, however, the mischief is clearly traceable to damp straw or shavings. Straw should be prohibited as a packing material. If possible, one should order one's goods to be sent off from Europe between May and September, or at any rate, at a time when there is no slush or soft snow on the ground. I find that the packing cases are filled with what looks more like stable litter whenever the case has been despatched during the winter months. In any case, I join with my *confrères* in the expression of the hope that the parent society may be moved into seriously taking up the subject of packing for shipment to distant countries.

* Varnished parts, whether of wood or metal, should not be wrapped in unprepared tissue papers, as is commonly done, but in the oiled or paraffined paper already referred to above.

THE CONGRESS OF THE "HOUILLE BLANCHE."

By MARCEL BLOCH, Ingénieur Civil.

The picturesque title of *Houille Blanche*, meaning literally "white coal," is applied to the power obtained from rivers and waterfalls deriving their flow from the glaciers and perpetual snows, and was originated by Aristide Bergés, the founder of the Lancey power installations. A long time has elapsed since M. Bergés was asked to submit a sample for analysis of the *houille blanche*, and at the present time the metaphor is known to the world as the motive power of the future. This is especially the case since the introduction of electricity has lent these enterprises an importance which is only now beginning to make itself felt, witness the power transmission plants and the electro-chemical industry. The fear that the coalfields would last but a limited time in European countries has disappeared before the new *régime*, and this fact cannot be overrated in connection with those countries which already import a large percentage of their coal, such as France, Italy and Switzerland. An estimate of Mr. Bergés places the hydraulic energy of the Alps and the Pyrenees at 10,000,000 H.P. There are now in actual use in France alone some 500,000 H.P. of this total. This figure already makes a difference in the consumption of coal in France, and the reserve remaining yet unshackled by man's labours will, it is estimated, make an annual saving in France of some 200 million francs which is yearly paid for importation of coal, amounting to some 13,370,000 tons out of an annual consumption of 45,200,000 tons.

The Congress was convened for the purpose of considering the best means of arriving at this desirable result and the legislation to be proposed with this end in view. Commercial questions were fully dealt with, and the technical aspect of the problems to be overcome was fully discussed The over-production of calcium carbide and other electro-chemical products hastened this movement, for power stations erected for this industry were in some cases obliged to turn their energies in other directions, and the want of legislative and commercial facilities in this connection caused them to gladly embrace any opportunity to further their objects.

There are now actually installed within a radius of 3 kilometres around the Niagara Falls, in North America, no less than 16 large electro-chemical companies using about 45,000 H.P., and this fact alone serves to illustrate the possibilities held out in the direction taken by the conveners of the Congress.

It is not proposed here to deal with the legislative side of the work of the Congress, for this can have but a local interest to the great majority of readers. The commercial aspect of the question, although interesting, is not yet sufficiently developed to merit a long description, and, moreover, its importance will appear when dealing with the technical points and the problems to be overcome in connection with the schemes of water-power installation.

We will now briefly deal with the technical propositions and ideas regarding this matter as set forth by members of the Congress, in the papers read, and in the visits which parties of the Congressmen made to various installations in the Alpine district.

The electrical characteristics of water power utilisation in the Alpine region will be more comprehensively illustrated by the following account of the visits made by the author to the interesting works of the region, than it would be by detailed reports from the electrical papers read at the technical meetings, these papers referring to matters of a more general character. Yet a summary of the most interesting papers may offer some interest to our readers. The highly-interesting paper on "Hydraulic Features of Alpine Installations," by Mr. Drouhm, will be treated with reference to the visit paid by the Congress, to the Livet station, which was so ably installed by Mr. Drouhm.

Mr. R. V. Picou drew attention to practical considerations to be taken into account in equipping an hydro-electric generating station, the most interesting of which are the following :—

1. The want of co-ordination between the hydraulic and the electric installation, necessitates an intermediary between the hydraulic and the electrical engineer ; he suggested that the direction be entrusted to a consulting engineer equally familiar with mechanical and electrical work. It should be noted that consulting engineers are rarely employed in France, customers as well as contractors failing to appreciate the advantages thus obtained.

2. Again, more attention should be paid to the ideas of the electrical engineer in charge of the work, who should be consulted simultaneously with the mechanical engineer in charge of the hydraulic work, and not after the choice of turbines has been made. American or English readers will no doubt wonder that such a defective practice should often prevail in France.

3. Mr. Picou warns electrical constructors against that class of installation known as *tours de force*, a kind of luxurious plant resulting in the construction of machines or switchboard at a cost out of all proportion to the expected paying properties of the plant. Such is the tendency to exceedingly high efficiencies, to too close regulation, or to costly construction of switchboards, frequently loaded with useless apparatus.

Mr. Ribourt, a well-known professor of the "Ecole Centrale des Arts et Manufactures," concurred with Mr. Picou in holding the turbine subordinate to dynamo construction, one of the most desirable conditions in these plants being good speed regulation.

Mr. Sloan pointed out the necessity for reliable and comparative tests of turbines, a necessity fully realised and complied with in the United States. A national testing laboratory and an association similar to the association now dealing with steam apparatus would bring about great improvement in the actual conditions of working. It is to be noted that these recommendations were accepted by the Congress.

We cannot help mentioning the work of Prof. A. Blondel on a method of quickly calculating overhead lines graphically, a description of which will be given in a future article.

Mr. Gall's paper on the actual status of the electro-chemical industries deserves more than passing reference, in view of the present commercial crisis in this industry and the ambitious expectations advanced when the installations were made.

Among the more important electro-chemical industries are :—

I.—(A) *Electrolysis of Sodium Chloride.*—

(1) By means of electrolytic cells provided with diaphragms, these diaphragms being intended to oppose the reaction of chlorine on caustic soda.

(2) The production of caustic soda in cells not provided with diaphragms, but using mercury as negative electrode. Mercury sodium amalgam is obtained, which is furthermore again treated by water and passed into soda and hydrogen. The Castner and Kellner apparatus is considered the best for this purpose, but although used largely in England and Germany, the Hulin process is better known in France. This latter process employs molten lead for forming the amalgam lead sodium compounds which are further decomposed by steam.

(3) The more modern density cells, used in Germany, include neither diaphragm nor mercury, the caustic soda being obtained from electrolysis of the sodium chloride solution, which deposits it in the cells by means of the higher density of this product in comparison with the sodium chloride solution.

(B) *Efficiency.*—It is certain that the apparatus now used for the preparation by electrolytic processes of soda and chlorine are more economical than the old-fashioned processes of Leblanc and Solvay, especially when water power is available to give a cheap supply of energy. The output corresponds to a production of 1,260 grammes of caustic soda and 1,325 grammes of chlorine—that is, about 400 litres an hour, with a current of 1,000 amperes, a maximum difference of potential of five volts which represents an expenditure of 5½ H.P. per kg. of soda per hour.

(C) *Consumption.*—It would seem that this industry has a bright future, but the principal use of chloride is in combination with lime to form hypochloride of lime, and 1 ton of soda suffices for over 2 tons of hypochloride of lime. The consumption of soda is, however, practically unlimited. In France alone there are 180,000 tons used per annum, whereas hypochloride of lime is scarcely required outside the trades of paper and paste making and for sanitary purposes, scarcely 20,000 tons being used in France. Under these conditions, a station producing up to 10,000 tons of soda, which is not a great total, can hardly dispose of all its chlorine. Other applications of chlorine are being sought out. One of these which would appear to be very suitable is tetrachlorure of carbon, a liquid body containing 92 per cent. of chlorine, with an agreeable odour, and possessing, like benzine, essences, and bisulphide of carbon, the property of dissolving fats, but with the advantage of being uninflammable and not forming explosive mixtures with the air. On all sides this new substance is being experimented with.

II.—The manufacture of alkaline hypochlorides is being carried out by several processes, the best known being that of M. Hermite. The electrolite, formed of two solutions of chlorure of sodium and chlorure of magnesium in water is in continual circulation from the bottom to the top of an electrolyser formed of a cast-iron galvanised bowl. The cathodes are formed of zinc discs mounted on two parallel arms and turning slowly. The anodes, the active surface of which is a sheet of platinum, are placed between each pair of cathodes. The intensity of current is 1,000 to 1,200 amperes under a potential difference of 5 volts. Paper manufacturers are in favour of this process.

III.—As is known, chlorates are used in connection with oxygen preparations, with certain pharmaceutic products, and in manufacture of matches. Recently the Cheddes station, with the aid of certain special and perfected apparatus, prepared, under the name of cheddite, an explosive of a power superior to those now in existence, which was at the same time less dangerous and easier to keep.

Finally, the lecturer said a few words regarding the numerous applications of electricity and electrolysis in organic chemistry. Included in these are—rectification of alcohols, their artificial ageing, preparation of colouring matters, electric tanning, &c.

(B) I.—Principal electro-metallurgical industries. The more important of these are the electrolytic refining of metals, copper, lead, silver, &c., which are worked by the wet process.

II.—The extraction of metals, sodium, aluminium, iron, &c., which is done by means of the dry process. Mr. Gall gave a list of the more important of these.

He also laid great stress on the importance of the regulations concerning the production of electro-chemical products, especially in regard to the tariffs for transport and the duties and customs payments on them, to enable easy exportation of the material, without which the industry would never be able to exist in the face of foreign competition. Certain measures for submission to the authorities were proposed to the Congress.

The administrative council of the syndicate which took the initiative in convening the Congress commissioned Mr. Bourcher to give special study to the problem, in a way so as not to overlap the investigations of other members of the Congress. Unfortunately, the Congress came to an end too soon for M. Bourcher to state fully his results in the matter, but he gave an interesting address regarding the method of effectually filtering the water before its use. He stated that a good intake in order to avoid the floating and suspended

matter, as well as the *débris* dragged along the bottom of the river, should be formed of perforated sheet metal placed in a horizontal position, which would allow all floating matters to pass over, including the ice, which is, in these regions, a formidable obstacle to these installations.

As regards the filtering of the sand and gravels, it was stated that the benefits to be derived from a decantation chamber were illusory in connection with torrential rivers and streams which are so liable to heavy floods, in which great quantities of matter were held suspended, due to the great speed of the flow of the water.

In order to avoid the silting up of decantation chambers, it is proposed that the water should be led into small canals in which the speed would be diminished to such an extent that the gravels and sands would be dragged along the bottom, allowing the matter to fall but not to remain on the bottom of the canal. This will not completely filter the water, but it has been found possible to work the installations with the tolerably pure water thus obtained. The canals are given such a section and slope that no deposit can be formed therein, and, in addition, it is necessary to adopt such types of turbines and distributors as will permit the rapid replacement of parts worn by the action of the sands. Complete data on the subject will be presented to the Congress.

(*To be continued.*)

NEW PATENTS APPLIED FOR, 1903.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

17,734. "An electrical magnetic automatic stop-action appliance to be used with fustian, corduroy, velvet cutting and other machines." R. Reynolds. August 17th.

17,744. "Improvements in and relating to the shifting of points and plough guides on electric tramways." W. J. Stewart. August 17th.

17,745. "An improved automatic safety device for use in connection with overhead electric conductors." A. Morris. August 17th.

17,767. "Improvements connected with the electrical propulsion of vehicles on the overhead system." C. S. McIntire. August 17th.

17,814. "Improvements in safety collision devices for electric tramcars." R. Haddan. (Ramon Rué y Montparlé, Spain.) August 17th. (Complete.)

17,851. "Improvements in or relating to electric railways." G. Westinghouse. August 18th.

17,869. "Improved process and apparatus for the production of alkalis and chlorine by electrolysis." E. A. Ashcroft. August 18th.

17,871. "Improvements in or relating to electric arc lamps known as flame arc lamps." C. Oliver. August 18th.

17,896. "Improvements in lifeguards for electric cars and other self-propelled vehicles." A. Royle. August 18th.

17,919. "An automatic emergency brake for electrically-propelled vehicles." J. Izett. August 19th.

17,974. "Improvements connected with electric lamp fittings." R. W. Braham. August 19th.

17,994. "A device for clamping a broken trolley-arm or pole on an electric tramcar." J. Dawes. August 20th.

18,010. "Improvements in galvanic batteries." L. Fiedler and F. J. Gerard. August 20th.

18,077. "Improvements in electric trolleys." J. Lauvernier. August 21st.

18,080. "Improvements in or connected with means for preventing corrosion and injury to water mains by electric currents received through the rails of tram lines." W. B. Leachman. August 21st.

18,121. "Improvements connected with enclosed or open electric arc lamps." L. C. H. Mensing. August 21st.

18,142. "Improvements in or relating to the receiver-cradles of telephone instruments." R. F. Hall and The Electric and Ordnance Accessories Co., Ltd. August 22nd.

18,143. "Improvements in or relating to telephone apparatus." R. F. Hall and The Electric and Ordnance Accessories Co., Ltd. August 22nd.

18,167. "Improvements in safety fuses." J. Sachs. August 22nd. (Complete.)

18,177. "Improvements in electric arc lamps." W. W. Smith. August 22nd.

18,185. "An improved electrically-controlled indicator." Siemens Bros. and Co., Ltd., and G. S. Grimston. August 22nd.

18,197. "Improvements relating to electric apparatus for motor-cars." A. T. Dawson. August 22nd.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1901.

16,827. "Improvements in apparatus for the electric ignition of the charges in internal combustion engines." J. Edmondson. Dated August 22nd.

16,847. "A new or improved cord grip for electric pendant lamps." R. O. Wright. Dated August 22nd.

17,029. "Improvements in lightning arresters." British Thomson-Houston Co. (H. R. Sargent, Schenectady, New York, U.S.A.) Dated August 24th.

17,282. "Improvements in incandescent electric lamps of the Nernst type." B. M. Drake, G. B. Ram, and Nernst Electric Light, Ltd. Dated August 29th.

17,766. "Improvements in and connected with electric cut-outs." H. Oppenheimer. (Actiengesellschaft Mix & Genest, 67, Bulow Strasse, Berlin, W.) Dated September 5th.

18,246. "Improvements in or connected with magnetic separators." C. Scholl. Dated September 12th.

18,314. Improvements in means for measuring the energy of three-phase alternating current circuits." F. Conrad. (Date applied for under Sec. 103 of Patents, &c., Act, 1883. February 14th.) Dated September 13th.

18,400. "New or improved controlling apparatus for electrically operated or driven ammunition rammers." A. Reichwald. (F. Krupp, Essen, Germany.) Dated September 14th.

18,480. "Improved means or apparatus for detecting or indicating light waves, Hertzian waves, and other radiations." J. C. Bose and S. C. Bull. Dated September 14th.

18,515. "Improved means for automatically indicating a rise in temperature." F. Castle and C. F. White. Dated September 16th.

18,577. "An improved push-button controlling electric lift." J. Bush and M. T. Medway. Dated September 17th.

18,600. "Improvements in the treatment or manufacture of paper applicable for use in electric insulation." J. B. Tayler. Dated September 17th.

18,666. "Improvements in bell-buoys." J. A. Fairbanks. Dated September 18th.

18,771. "Improvements in connection with apparatus for advertising and like purposes by changing lights." D. Millar. Dated September 20th.

18,816. "Improvements in and relating to medical chairs." J. J. Stanger. Dated September 20th.

1902.

1,402. "Improved means for operating the joints of the overhead wires and of the rails on electric tramways." H. Collins and C. W. Collins. Dated January 18th.

1,417. "A new or improved electric meter." F. Wyatt. Dated January 18th.

1,435. "Improved coupling joint or connection for electric wires and fittings." M. Railing and G. H. Ide. Dated January 18th.

1,475. "An improvement in feeder pillars for electric traction." C. Beckingsdale. Dated January 20th.

1,496. "Improvements in electric switches." H. H. Berry, P. F. W. Simon and E. Skinner (trading as Simon, Berry & Co.). Dated January 20th.

1,528. "An improvement in the manufacture of incandescent electric lamps." P. Scharf. Dated January 20th.

1,537. "Improvements in and connected with insulators for closed conduits." W. Griffiths and B. H. Bedell. Dated January 20th.

1,546. "Improvements in the lighting of electric cars operated by the overhead conductor system." H. McGillivray. Dated January 20th.

1,688. "Improvements in the electrolytic separation, deposit and refining of zinc." H. Paweck. Dated January 21st.

1,736. "Improvements in arrangements for controlling and regulating the supply of electricity to medical heating apparatus and the like." A. Phillips. Dated January 22nd.

6,884. "Improvements in telephonic apparatus." A. Graham. Dated March 20th.

10,952. "Improvements in or relating to electric alarms operated by clockwork." E. R. Mannel. Dated May 18th.

11,269. "Improvements in wireless signalling." J. Munro. Dated May 16th.

11,323. "Improvements in electric meters." Aron & Flower.

11,377. "Improvements in fittings for metallic conduit systems of electric wiring." L. M. Waterhouse and Simplex Steel Conduit Co., Ltd. Dated May 17th.

11,393. "Improvements in apparatus for controlling and operating the points of electric railways and tramways." W. H. Stewart, T. B. Turner and R. E. Dixon. Dated May 17th.

11,829. "Improvements in starting devices for electromotors." H. H. Lake. (General Electric Co.) Dated May 24th.

11,831. "Improvements relating to the field magnets of dynamo-electric machines." H. H. Lake. (General Electric Co.) Dated May 24th.

11,832. "Improvements in oil guards for the commutators of dynamo-electric machines." H. H. Lake. (General Electric Co.) Dated May 24th.

11,833. "Improvements in electric switches." H. H. Lake. (General Electric Co.) Dated May 24th.

11,835. "Improvements in electric speed regulators." H. H. Lake. (General Electric Co.) Dated May 24th.

11,837. "Improvements relating to electric railway working on a sectional conductor or like system." H. H. Lake. (General Electric Co.) Dated May 24th.

12,030. "An improved electric autocar for conveying heavy articles in factories and the like." C. Heuze. Dated May 27th.

12,083. "Improvements in or relating to electric arc amps." H. H. Lake. (General Electric Co.) Dated May 27th.

12,156. "Improvements in electric incandescence lamps." C. D. Abel. (Siemens & Haiske Aktiengesellschaft.) Dated May 28th.

12,162. "Improvements in the manufacture of filaments or the like for electrical incandescence lamps." C. D. Abel. (Siemens & Halske Aktiengesellschaft.) Dated May 28th.

12,292. "Improvements in electrical cut-outs or fuses." H. H. Lake. (General Electric Co.) Dated May 29th.

12,293. "Improvements relating to electric fuse boxes." H. H. Lake. (General Electric Co.) Dated May 29th.

12,909. "An improved electric heating device." F. de Mare. Dated May 29th.

13,914. Improvements in and connected with telephone connections in the party line system." H. Oppenheimer. (Actiengesellschaft Mix and Genest.) Dated June 19th.

14,109. "Improvements in electro-magnets." J. A. Timmis and E. W. Timmis. Dated June 21st.

14,286. "Improvements in and connected with the control of electrically-propelled vehicles and trains." T. A. Hearson. (Sprague & Carichoff.) Dated June 21st.

14,349. "Improvements in electrostatic apparatus for measuring potentials. J. Ferguson and K. White & J. White, Ltd. Dated June 24th.

14,430. "Improvements in type-printing telegraphic instruments." F. H. W. Higgins. Dated June 25th.

1903.

4,208. "Improvements in and relating to the cells of primary and secondary electric batteries." W. E. Heys. (The Hutchison Acoustic Co., United States.) Dated February 23rd.

4,234. "Improvements in and connected with electric batteries." H. Piquer. Dated February 23rd.

4,311. "Improvements in electric insulators." W. Brandes. Dated February 24th.

4,323. "Improvements in telephone selecting devices for telephone systems and other purposes." W. D. Watkins. Dated February 24th.

4,368. "Improvements in electrodes for reversible galvanic batteries." H. Cottrell. Dated February 24th.

4,369. "Improvements in frames for battery electrodes." H. Cottrell. Dated February 24th.